A TREATISE

ON

TOPOGRAPHICAL ANATOMY;

OR,

THE ANATOMY

OF THE

REGIONS OF THE HUMAN BODY,

CONSIDERED IN ITS RELATIONS WITH

SURGERY AND OPERATIVE MEDICINE.

WITH AN ATLAS OF TWELVE PLATES.

BY PH. FRED. BLANDIN,
PROFESSOR OF ANATOMY AND OPERATIVE MEDICINE, ETC.

TRANSLATED FROM THE FRENCH,

BY A. SIDNEY DOANE, A.M. M.D.

WITH ADDITIONAL MATTER AND PLATES.

NEW YORK:
MOORE & PAYNE, UNIVERSITY BOOKSTORE, CLINTON HALL.
COLLINS & HANNAY, 230 PEARL STREET.
M DCCC XXXIV.

SLEIGHT & VAN NORDEN, PRINT.

TO

GEORGE B. DOANE, A. M., M. D., M. M. S.

MY DEAR SIR,—

In dedicating this translation to you, allow me to express my respect for your talents and acquirements: your classical acquaintance with the modern languages has opened to you sources of professional information which are closed to many; while your mind is well stored with facts, gleaned by years of laborious practice, both at home and abroad. You are now actively engaged in the cause of humanity; and, while expressing a wish that your merits may be properly appreciated, your exertions richly rewarded, may I ask the continuance of your valued friendship?

With much esteem,

A. SIDNEY DOANE.

PREFACE.

The object of *Blandin's Treatise on Topographical Anatomy*, a translation of which is now offered to the medical profession, is, "to examine the organs in each part of the body, leaving out of view their analogies: in other words, to study the regions formed by nature, which are always combined so as to place the organs in as little space as possible, without injuring the action of any of them. This science has been pursued by men of great talent; its elements are for the most part known, and are mentioned in the excellent treatises in descriptive anatomy of Meckel, Beclard, Lawrence, Cooper," &c. &c. The plan pursued by Blandin, as stated in his preface, is as follows: "Since the elements of topographical anatomy," he says, "are derived from descriptive anatomy, we have carefully refrained from encroaching upon the bounds of this latter science. In this respect, we have followed strictly the plan of Beclard, who delivered several courses of lectures on this subject. The details of descriptive anatomy, in each region, are but few, and are presented merely to refresh the mind of the reader: sometimes, however, we have varied from this course; first, as when examining parts not described in descriptive anatomy, as the aponeuroses: second, when the descriptions commonly given are imperfect: third, when stating new or curious details: we have also mentioned the varieties of the animal tissues, when speaking of the different regions.

"It follows, from these remarks, that a work of this kind cannot be studied, except by those who have some knowledge of anatomy, and cannot take the place of a work on descriptive anatomy: for, either it includes all the special details of the organs, and then it is not a work on topographical anatomy, but a treatise on descriptive anatomy, in which the arrangement is bad: or, the descriptive details are very brief, and insufficient for those who wish to study the special structure of the organs.

"The method of description followed in this work is the synthetical: from general remarks on the human body we have descended to its secondary divisions, and then to the regions, where we have entered upon the true details of topographical anatomy.

"Such is, briefly, the plan of this work, in which we have attempted to establish the important relations of anatomy with medicine, and particularly with surgery. For the details, we have consulted the works of the most eminent anatomists and surgeons of the age; while every assertion has been verified by the scalpel, which has led to some interesting discoveries: occasionally, we have attempted to render the subject less dry, by references to comparative anatomy; and in order to make the description of the most important and complex regions more intelligible, drawings of them have been made from nature, by Jacob, one of the ablest artists in France.

"Finally, this work is designed for medical students generally: it will be found of assistance in dissections, inasmuch as each region presents, in distinct articles, every thing in respect to its external or internal form, and to the elements and relations of its structure; these subjects should be investigated in the dissecting room; while our remarks upon the development and uses of the regions, and the pathological and operative deductions, can be studied in private, and are naturally deduced from the former."

In regard to the American translation we would state, that a treatise on Topographical Anatomy being called for by the profession, we selected the work of Blandin, which is considered, by the best judges, to be extremely valuable. It has been translated with the utmost care; the errors of the original have been corrected; a few alterations have been made, in which we have followed strictly the plan of the author. Four new plates have been added. One from Watts; *A perpendicular section of the head and neck, to show the relative situations of the cavities of the Nose, Mouth, Larynx, and Pharynx;* a second, *Illustrating those parts of the eye most concerned in surgical operations;* a third, *A front view of the Axilla;* a fourth, from Scarpa, *Illustrating the anatomy of Hernia.* These, it is thought, will render our translation still more valuable.

Before concluding, however, we would call the attention of our readers to the mechanical execution of the work, which is extremely fine: the plates have been drawn in a style of uncommon beauty, by Mr. D. G. Johnson, an artist of great merit, while the typography is unsurpassed by any medical work in this country.

December 17, 1833.

CONTENTS.

INTRODUCTION.

Although the number of bodies on the surface of the globe is great, yet they may be divided into two large classes: the first includes inanimate objects, the second, organized bodies: the former are aggregates, formed by the influence of attraction; the latter, although subjected to physical laws, are composed of elements which would rapidly separate, were they not united by a power, the principle of which is unknown while its effects are palpable: *the vital power.*

The general knowledge of nature, or natural philosophy, is based on the analogies presented by all these bodies, and is divided into two great sections, one of which treats of the inanimate objects, the other of the organized bodies.

The science of the organized bodies is the more interesting and more useful to the physician: the subjects on which it treats are of two kinds, and are either vegetable or animal; these differ principally in the power of sensation, which exists only in the latter. Sometimes this science treats particularly of their classes, their manners, and their habits: sometimes of their structure: finally, sometimes it points out only the action of their organs, in natural history, anatomy, or physiology, three sciences, which, although very distinct, present many points of resemblance. Of these, anatomy is undoubtedly the first and most useful: it serves as the base of the other two, and furnishes a great number of facts, useful in the study and treatment of diseases: in fact, the physician should be intimately acquainted with the organs in their healthy state, in order to estimate properly, their numerous and varied morbid alterations. Anatomy is particularly necessary to the surgeon: when he plunges his knife into a part, he should be able to guide it with as much boldness, as if the whole body were transparent, and he could follow its course with his eye.

Anatomy, in its most extensive sense, embraces the whole organic kingdom, and treats of the generalities of the structure of all the

beings which compose it: when this general anatomy is studied in a narrower point of view, and we refer to a single class or species (in order to know particularly its minute structure,) the ideas we have of the structure of all the others, it is termed comparative or compared anatomy.

Anatomy, then, in its most general sense, is divided into phytotomy, which treats of the peculiar structure of vegetables, and zootomy, which embraces that of animals: these great divisions also are more or less subdivided, according as the organization is studied more minutely: and finally, we arrive at the examination of one species, which is special anatomy, in which class is found anthropotomy. These are the divisions generally admitted in anatomical science; but we must allow that they are by no means so strict as they appear to be at first view: in fact, as they are established on the classes, families, genera and species of the organic kingdom, they have no foundation except that presented by these latter. But these classes, families, &c., although formed as well as they can be, are merely simple abstractions, made to facilitate their study. To understand this truth completely, let us examine the extremity of the organic kingdom: we there see that the naturalist is embarrassed in deciding upon the place to be occupied by certain beings, species of hermaphrodites, which do not belong to any one of the great classes of natural bodies, more than to another; hence, men of science have been led by these facts, to consider the different individuals of the organic kingdom as forming only one great family, in which they must be arranged in the orders of their affinities; thus forming a kind of scale with imperceptible but continuous gradations, from man, who occupies the summit, to the most simple vegetables which mark the lowest degrees. Each being in the *adult* or *perfect* state, occupies a more or less elevated determinate degree, in this organic scale; but a remarkable fact has been established by the profound labors of Tiedemann, Meckel, and many others; viz., that it passes through, in the course of its development, several of the degrees which are lower than that properly belonging to it, and successively assumes, by more or less evident changes, states which other organized beings permanently possess.

Hence, in an anatomical description, we ought to note carefully the actual ages of the beings examined, if we do not wish to place in one degree of the organic scale a body which really belongs to another: descriptions should always be based upon the adult or perfect state: in fact, we ought first to consider abstractly the varieties belonging to individuals and to sexes, which, however, as well as the differences depending on development, should be carefully noted.

OF THE ANATOMY OF MAN.

Human anatomy, or anthropotomy, to which we shall now attend, is, therefore, only a small division of the general science of the organization, and it has for its object, the knowledge of those beings who stand first in the scale.

Dissection, the only mode of gaining a profound knowledge of anatomy, has been carried to such perfection, that in order to describe the human body by commencing at its elementary parts, we must begin far beyond the attainments even of very modern anatomists. We shall not mention the microscopic globules, which have been studied by Leuwenoech and Hewson particularly, and which seem to attract anew the attention of scientific men; these have been found by Milne Edwards to be similar in all the tissues—presenting in every part one three hundredth of a millimeter in diameter; these globules are not true anatomical elements:* our organs are composed of a certain number of fibres, which unite in various modes to form the simple organs or elementary tissues, while these combine and give rise to complex organs, which, collectively, form the regions and the whole body. The elementary fibres generally admitted are three: viz., the *cellular*, the *contractile*, and the *nervous*. The author of "*Nomenclature Anatomique Moderne*" adds also the *albugineous fibre*, which he considers with Beclard, as a more or less remote modification of the cellular fibre, grounding his opinion on its development, its chemical composition, and the phenomena which attend its decomposition by maceration. Blainville goes still farther: he admits only the cellular and the nervous fibre, and considers the contractile fibre only as a modification of the former: in fact, he remarks, that the lowest animals move, although they have no muscles, and the motions are produced by the cellular fibre. This opinion of Blainville, which at first view appears singular, deserves much more serious attention, because in some parts of man, the cellular tissue becomes *semi-contractile*, as in the dartos, and in other cases, we find a tissue, which, in respect to its properties and chemical composition, seems to establish the transition between the cellular and muscular tissues;†

* The chemical elements of the animal tissues are principally oxygen, hydrogen, carbon, and azote; simple bodies, to which others are added. These elements combine, and form the immediate principles, which become in their turn the base of the anatomical elements.

† We have frequently observed a small muscle extended between the styloid process and the top of the small horn of the hyoid bone, in place of the stylo-hyoid ligament As this ligament is formed in the normal state of elastic fibrous tissue, we can easily conceive of its change into a muscle.

this is the yellow fibrous or elastic tissue, which contains a good deal of fibrin. We shall not mention the unique, invisible, and ideal fibre of the ancients, which they considered as formed of water, earth, and fire.

The organs, solid parts, which have an action in the system, are very numerous; they are divided into simple and complex organs: the simple organs are generally distributed over a great many parts of the body, and their structure is simple, being *cellular, adipose, fibrous.* The complex organs are formed of a variable number of simple organs, to which are added other complex organs, as the vessels, &c. The stomach, for instance, is a complex organ, formed of the cellular, and serous tissues, &c., *simple organs,* to which are added vessels and nerves, *complex organs.*

The simple organs, which are distributed generally in the human body, present a great number of analogies: the complex organs offer others, which, although less numerous, are not less real: hence the idea of uniting in one branch of science all these generalities of organic bodies, to which we owe *general anatomy,* or rather the general anatomy of the organs, which may be defined the science of the generalization of the organs. Bichat, in his immortal work, when speaking of the simple organs, as the cellular tissue and the fat, does not confine himself to general remarks, but enters into particulars on these tissues considered in respect to the regions: he consequently encroaches on the domain of *topographical anatomy,* which is now established and claims these particulars, which do not belong to the science of the generalization of the organs.

The description of the internal and external forms, and also of the structure and development, of the complex organs, is the subject of *descriptive anatomy,* for which the *special anatomy of the organs* would be a better term: for the descriptive mode is far from being confined to this alone. Finally, the particulars of the simple organs and the general remarks on the grouping of all the organs, form the elements of *topographical anatomy.*

We distinguish three species of groups of organs: the *system,* the *apparatus,* and the *region,* of *organs.* The *system* is an imaginary group of analogous organs, from which some remote considerations are deduced: the *apparatus* is a natural group formed of organs which take part in the same function: this comes within the province of physiology, or rather of descriptive physiological anatomy. Finally, the *region* is also a group formed naturally, (sometimes in a physiological point of view, sometimes from their locality;) by organs which frequently present but slight analogy of form and structure: it belongs to *topographical anatomy.*

OF TOPOGRAPHICAL ANATOMY.

Topographical anatomy, or the anatomy of the regions, to which alone we shall attend, may be defined, the *science of the local organization.* It has for its subject the groups of organs of the third order. The purpose of topographical anatomy is the knowledge of the regions and of the whole body considered by masses; but in order that this purpose may be completely attained, it does not treat merely of the relations of organs in the different parts: still less must we merely describe them by regions: but we must examine minutely the whole formed by their local union. Farther, from the avowed purpose of topographical anatomy, viz., the particulars of the simple tissues considered according to their regions, and general remarks on the organic groups which constitute the latter, it is evident that this important branch of anatomy supposes as known, the *generalities of all the organs, and the particulars of the complex organs*, or general anatomy, and descriptive anatomy: hence it would be absurd to commence the science of the organization by the branch of which we are treating; this would be to attempt to study the most complicated of all the machines by merely inspecting it externally, and before acquiring a minute knowledge of its different wheels.

Topographical anatomy has been termed also, *surgical anatomy, the anatomy of relations, &c.* The first term is founded on its direct importance to the surgeon; but as topographical anatomy is also sometimes useful to the physician, especially as it belongs necessarily to every complete course of anatomy, it follows, that like many other scientific terms, this term is improper, because it limits the idea of the science of the regions. The term the *anatomy of relations*, is not so bad: but it is also defective, as it supposes, *a priori*, that the relations of contiguity are alone to be considered. The term *topographical anatomy* does not confine the subject of the science; it is most suitable, and farther, it is sanctioned by Meckel, Roux, Beclard, Cloquet, and others.

OF THE REGION IN GENERAL.

A region is a more or less extensive space, with more or less exact and natural bounds. In topographical anatomy, this term is applied to the different sections of the body, which are to be examined by the anatomist.

The surface of the human body is very extensive, and the regions which compose it are very numerous. We can conceive that their number may be very great, simply from the definition, since an anatomist may divide a single region into two or three which are smaller. Still the bases of the topographical division of the body are more certain than they at first seem: and when we reflect maturely, we easily discover that nature herself has often marked them by ridges of bone, or by muscular prominences and depressions: and we particularly observe, that around each important part of the skeleton, a number of organs generally seek support. We have constantly used these bases of the general arrangement of the organs for the establishment of the regions, which were also the bases of the divisions admitted by Beclard, in his lectures.

By forming the regions in this manner, they are natural, and more simple for the pupil who wishes to study them, since it is much more easy to determine the place where his investigations must cease; they give rise particularly to more extensive remarks in respect to their uses, and to the action of their organs, or in their applications to medicine. Who, for instance, can hesitate upon the impropriety of separating the axilla into several regions, or of uniting in one the groups of organs formed around the clavicle, the scapula, and their union with the trunk? If the anterior and lateral abdominal parietes were divided into several regions, should we not be obliged to state in each of them, that we always found the *skin, fascia superficialis and obliquus abdominis externus* muscle? Does not the inconvenience which would follow in generalizing the uses of this wall, in vomiting for instance, or in examining its alterations in many cases, prove this? How inconvenient it would be also to separate the thigh into several regions? Not to mention the want of exact boundaries for these limits, the uses of the thigh are such, that only a bad idea of them can be formed by dividing them and referring them to different parts: and finally, when for instance, we wished to ascertain by anatomy, to what extent after the femoral artery was tied, the circulation could be re-established in the lower part of the limb, we should have to call to mind the ana-

tomical relations of all parts of the thigh, since the collateral arteries, which are then so useful, are distributed in every part; hence the pupil would find it extremely difficult to know to which crural region, to the anterior, to the posterior, or to the lateral, he must refer these important deductions of pathological anatomy. Still the desire for forming regions in the best manner for obtaining the most general deductions, must never induce us to include in one region, one system of organs, unless these are all placed exactly in the same situation, as is seen in the *external and internal orbitar* regions. We must not, for instance, include the maxillary and frontal sinuses in the internal olfactory region, although they make part of the olfactory apparatus: this in fact would be acting contrary to the simplest rules of topographical anatomy: the frontal sinus is one of the elements of the supraciliary region; the maxillary sinus belongs to the skeleton of the cheek. The multiplicity of objects, however, in certain parts, and at the same time the necessity of exposing their relations minutely, sometimes require the formation of artificial sections, in order to confine their examination within narrower limits, and thus to facilitate the study. An idea of the division of the human body into regions, and particularly of our plan, can be obtained by inspecting the table at the end of the introduction.

The different regions also, may be distinguished into natural and artificial, of which the former are more numerous; and as there are simple and compound organs, so likewise there are simple and compound regions; we have also noted in another place, the analogy between the regions and the organs.

All the regions are moulded on the skeleton, and present the same general arrangement: some are elongated as those of the limbs; others are flat, and contribute to form the parietes of the great cavities; finally, others are short and thick.

Every region should be considered in respect to its external form, its depth, direction, breadth, structure, development, varieties, and uses; this is the only manner of deriving from the topographical study of the body, all the advantages in respect to pathology and to operations that we have a right to expect; finally, it is only after following a region in all its details that we can resolve the problem which has been so long proposed by surgeons, viz., *of interpreting operative medicine by anatomy.*

When some regions contribute to form a cavity, if this opens externally, as the mouth, we must first describe the cavity; in the contrary case, as in the abdomen, the explanation of the regions must precede that of the cavity. The explanation of the structure of a region embraces two things: the enumeration of its component elements,

and the minute examination of their relations of integrity; the first part is merely an enumeration, since all the elements of a region are supposed to be known, and are described in treatises on descriptive anatomy; however, our course may be varied by circumstances.

The elements of a region must not be enumerated arbitrarily. Each presents resisting parts of bone or of some other character, which form its skeleton or point of support; these elements should be examined first. Next come always the more or less muscular parts, in the interstices of which the vessels and nerves ramify; among these some only pass through the region, and go elsewhere, and others terminate in it. In each region, the vessels communicate by more or less marked anastomoses, which are always very important, because, being frequently formed by branches which arise from different trunks, or from the same trunk and at different heights, they establish in the region a very curious collateral circulation. The vessels and the nerves of most of the regions, come from trunks which also furnish them to other regions more or less adjacent, which circumstance causes sympathetic affections of different kinds between them, which it is also very important to notice. In all the regions we find some cellular tissue, and a greater or less quantity of adipose vesicles, which should be carefully noted, as also the different densities of the simple organs, not only in the region generally, but also in its different points. Finally, most of the regions present an external face, and consequently a part of the skin enters into their composition, and we have to consider its density in different parts, its greater or less number of follicles, and the hairs which cover it.

The relations of the organs of the regions, form a very important part of topographical anatomy, and are universally considered as such: but we have satisfactorily proved, that the relations are far from constituting the whole of this science. There are certain regions where the organs form very well marked and superimposed layers, in others on the contrary the arrangement differs. In the former, the study of the relations is very simple, but in the latter, very complex. This study of the layers of a region may be made from the deep to the superficial parts, but it is more convenient to commence in the opposite manner; first, because in dissection the superficial layers are divided first; and secondly, because in operations, the surgeon cuts in this direction. In regions where resisting aponeuroses exist and form the sheaths of the organs, it is very easy for the study, and also for the description, to examine successively the secondary organic groups, which are bounded by aponeurotic layers; thus, when this method is applied to the perineum, it simplifies the explanation of the complex arrangement of the organs of this important region; in the

limits, also, it is very easy to consider successively the relations of the organs in each of the great sheaths, which are formed by the large aponeuroses existing there.

Each region presents a perfect state, which must be considered as the type of the first description; but to arrive at this state, the region, and also the whole individual, passes successively through a certain number of periods of unquestionable importance, which in our opinion will be demonstrated in the course of this work.

Beside the more or less apparent variations presented regularly by the regions considered at different ages of life, there are others which, in the perfect state, depend on the sexes, and finally there are some which depend on circumstances which we can neither foresee nor calculate upon: these anormal arrangements, whether they affect the general form of the region, or belong specially to one of its elements, sometimes produce secondary modifications in the normal relations; but this is not always the case. The organic varieties sometimes consist in an increase or diminution of the usual arrangement; sometimes they cause certain analogies between different regions of the body, or between groups of animals which differ in their position in the animal scale: finally, sometimes they establish great analogies between the different systems of the same organism, particularly between the different orders of vessels, or between these and the nerves. All these varieties are important, as they may require peculiar precautions in the modes of operating.

All regions which are naturally bounded have evident uses: sometimes they contribute, as in the limbs, to form pillars of support: sometimes, as in the trunk, they circumscribe great splanchnic cavities. Some regions are extremely movable: others are fixed. These remarks on topographical physiology are highly important in certain points where the regions are always more or less modified during their action; they show in every part the relations of sympathy between the different parts of the body, relations of which an idea is easily formed by considering the communications of the nerves and vessels.

Finally, when a region has been studied, it becomes easy to form an idea of its different pathological states; and we can study to more advantage surgical operations particularly, which are intended to restore more or less perfectly the normal state, by acting upon the surface of a part or upon the deep organs. Thus, by a knowledge of the action of each of the muscles of a region, and of their combined action, and considerations peculiar to this, we can explain the different displacements in fractures of its skeleton or its dislocations. By the arrangement of the vessels and the collateral passages in a

region, we can explain the re-establishment of the circulation, where the principal vascular trunks are obliterated: we can account for certain local congestions in regions which are not irritated, but which are situated near others which are, as redness of the eye, rumbling in the ear, cerebral irritation, &c. These deductions, besides being useful in pathology and operative medicine, are also of service in engraving firmly upon the memory the most minute details of topographical anatomy. Farther, the importance of anatomy generally, and particularly of topographical anatomy, to physicians and surgeons is now admitted, and it is unnecessary to urge its claims. In fact, without an intimate knowledge of the axilla, who would dare open the simplest abscesses, or use a cutting instrument in this part, where the slightest error might be fatal? Who would presume to operate for hernia, to tie the carotid artery, or to open the trachea, if he were not intimately acquainted with the regions on which these operations are performed? Is it not topographical anatomy which teaches in certain cerebral inflammations to apply leeches behind the ears, or to the pituitary membrane, or to the upper region of the head, &c.? And is it not an intimate acquaintance with the costal region, which teaches us in affections of the pleura to apply leeches, blisters, and other similar remedies on the side of the thorax, over the digitations of the serratus magnus muscle; and that if used on the arm, the same applications will be much more powerful if employed on its inner side?

TABLE

OF

THE REGIONS OF THE HUMAN BODY.

HUMAN BODY.

REGIONS.

- Splanchnic part. TRUNK.
  - Extremities.
    - Cerebral. HEAD.
      - Cerebral portion. CRANIUM.
        - Parietes.
          - Loose part
            - Arch .... Occipito-frontal.
            - Lateral parietes.
              - Anteriorly .... Temporal.
              - In the middle .... Auricular.
              - Posteriorly .... Mastoid.
          - Attached part. Lower wall .... Of the base.
        - Cavity .... Internal of the cranium.
      - Portion of the organs of sense. FACE.
        - Nostrils.
          - Prominent portion (nose) .... External olfactory.
          - Deep portion (nasal fossæ) .... Internal olfactory.
        - Mouth.
          - Upper wall .... Palatine.
          - Lower wall .... Glosso-supra hyoid.
          - Anterior wall
            - Around the mouth .... Labial.
            - Below the mouth .... Mental.
          - Posterior wall .... Palatal.
          - Lateral wall
            - Anteriorly .... Malar.
            - Posteriorly .... Tonsillar.
        - Orbits.
          - External portion .... Ext.-orbitar.
          - Deep portion .... Int-orbitar.
        - Zygomatic fossa .... Zygomatic.
    - Coccygeal.
  - Central portion.
    - NECK.
      - Tracheal portion.
        - Natural groups
          - Above the hyoid bone.
            - In the centre .... Glosso supra-hyoid.
            - On the sides .... Parotid.
          - Below the hyoid bone.
            - In the centre .... Laryngo-tracheal.
            - On the sides .... Supra-clavicular.
        - Artificial groups formed around
          - The sterno-mastoid muscle .... Sterno-mastoid.
          - The carotid artery .... Carotid.
      - Cervical or posterior portion .... Nuchal.
    - CHEST.
      - Parietes.
        - At the Sternum, ... Sternal.
        - ——— Ribs, ... Costal.
        - ——— Spine, ... Dorsal.
        - ——— Diaphragm .... Diaphragmatic.
      - General cavity
        - Septum .... Mediastinal.
        - Lateral parts .... Pulmonary.
    - ABDOMEN.
      - Parietes.
        - Anterior and Lateral .... Costo iliac.
        - Posterior.
          - At the Spine .... Lumbar
          - ——— Int Iliac fossa .... Iliac.
          - ——— Union of this wall with the thigh ... Inguinal.
        - Superior .... Diaphragmatic.
        - Inferior.
          - In the outlet of the Pelvis .... Perineal.
          - Circumference of the Pelvis.
            - On the inside .... Intra pelvic.
            - On the out-side.
              - Forward
                - Pubic.
                - Testicular.
                - Scrotal.
              - Backward .. Sacral.
      - Cavity .... Internal abdominal.
- Appendages.
  - Thoracic.
    - FIRST SECTION. Shoulder.
      - At the Clavicle .... Clavicular.
      - ——— Scapula .... Scapular.
      - ——— Scapulo-humeral articulation .... Scapulo-humeral.
      - Union of the shoulder and trunk .... Axillary.
    - SECOND SECTION. Arm.
      - At the Humerus .... Brachial.
      - ——— Humero-cubital articulation .... Of the elbow.
    - THIRD SECTION. Fore arm.
      - At the bones of the fore-arm .... Anti-brachial.
      - ——— Radio-carpal articulation .... Carpal.
    - FOURTH SECTION. Hand.
      - Undivided part .... Palmar.
      - Loose and divided part .... Digital.
  - Abdominal.
    - FIRST SECTION. Haunch.
      - .... Glutæal.
    - SECOND SECTION. Thigh.
      - At the thigh .... Crural.
      - ——— Femoro-tibial articulation .... Of the knee.
    - THIRD SECTION. Leg.
      - At the bones of the leg .... Of the leg.
      - ——— Tibio-tarsal articulation .... Of the ancle.
    - FOURTH SECTION. Foot.
      - Undivided part .... Plantar.
      - Loose part .... Of the toes.

TOPOGRAPHICAL ANATOMY.

OF THE HUMAN BODY.

Man, placed at the head of the scale of human beings, possesses all their general properties, and is distinguished from them by peculiar characters, particularly by his intelligence; hence the immense analogies with which our subject abounds, and which belong to the general science of nature; hence also certain differences, which it is the object of this treatise to point out.

Man is alternately in a state of rest and of motion; in a state of rest, his history belongs to anatomy; physiology treats of him only in a state of motion. In both cases, the science of the organization is the same, and the complete separation of these two states would be almost impossible, and would injure the advance of the science. The physiological remarks of Bichat upon general and descriptive anatomy, have sufficiently demonstrated the advantages of an opposite course in regard to these sciences, and it would be very erroneous to believe that topographical anatomy was an exception. In fact, every region of the body has peculiar uses, which are perfectly inseparable from it. This kind of physiology, which may be called topographical, is often blended with that of the apparatus of organs; but again, it is entirely distinguished from them; it has a special character, and must be studied separately. These physiologico-topographical considerations are highly important in certain regions, which are considerably modified in an anatomical point of view, solely by the action of the organs.

There is no comparison capable of demonstrating exactly the form of the human body: roundness, however, is one of its characteristics. Generally speaking, the height of the body is between five and six feet, its breadth is much less. The centre of the height of the body always falls upon the pelvis; it varies, however, in the two sexes, as we shall see hereafter. The centre of its breadth is marked by a sort

of raphe, which also varies very much; this raphe is situated on the median line, or rather in an antero-posterior median plane, which divides the body into two nearly similar halves; it is in relation to this plane that the human body is represented by all anatomists, to be symmetrical. This symmetry, however, which appears in the adult so perfect in masses, becomes much less so, if we regard it in detail; the regions and the organs which compose them, will furnish us constantly the instances of this. Bichat has said too much in favor of the symmetry of the organs of relation, and has touched too lightly on that of the organs of nutrition. The two kidneys and the bladder are certainly more symmetrical than the summit of the cerebral hemispheres and the vertebral column in the back. Farther, the symmetry varies very much. Authors, and particularly Meckel, speak of the symmetry between the upper and lower extremities; we admit that there is an analogy between them, but there is no similitude, and consequently no symmetry.

The natural direction of the body when in motion, is vertical; all the sophisms of philosophers to show that we were born to be quadrupeds, are refuted by anatomy, which constantly proves the contrary. In this posture, the axis of the body or the true median line, which, passing through the centre of the three splanchnic cavities, should fall between the feet upon the ground, forms with it an angle of ninety degrees. In a state of absolute rest, the body could not preserve this position; it proceeds horizontally, rests on the back, and always inclines to the right; this arrangement is produced by the greater development of the right portions of the body, and by the existence of the liver on this side, the weight of which is only compensated in part, by that of the spleen on the left.

Some men of science, deceived by the remote analogy of animals articulated externally, have asserted that the body of man is formed of a certain number of super-imposed and more or less similar layers, some of which are extended to form the limbs. This truly philosophical idea, which could have been formed only by those who possess a minute acquaintance with our organization, and with that of animals, must be mentioned in the general examination of the body; but as it refers particularly to the trunk, we shall avail ourselves of it on that occasion. The human body has for a base the skeleton, upon which its general form depends; other parts, which are less resisting, are superadded,* and form the surfaces, which are sometimes strong and vigorous, and sometimes graceful and delicate. The body of man is

* All the vertebrated animals present the same arrangement: their skeleton is internal; they are said to be articulated internally; other animals have a skeleton on the outside of the muscles: they are said to be articulated externally.

developed very curiously; it passes successively through a certain number of phases, each of which represents permanent states in the scale of animals; thus, for instance, although at first a zoophyte, its organization afterwards becomes more complex, until it finally acquires its elevated position in the animal scale.

These changes, to which all animals are subjected, were discovered long since in some of them, particularly in insects, because in them they take place slowly, and are easily observed. In man, on the contrary, they occur so rapidly as to have escaped observation, until recognized by the labors of Meckel, Tiedemann, St. Halaire, Blainville, &c. These changes, which are so various and numerous in the early periods of life, are repeated after birth, and produce the differences of the ages.

When conception occurs, our body is entirely fluid, and gradually assumes its density.

These changes in the form take place more rapidly than in the structure, but can not be overlooked. The human fetus soon tends to assume that form which will characterize it in the adult state.

In the early periods of the fetus, when its analogy with other animals is greater, the greater is the symmetry between the sides of its body, and the central point of its height falls on a point which is nearer the head.

The whole organism is formed like the elements, of separate parts which unite more or less rapidly; in the early periods of fetal existence, the direction of the body is that of a regular curve concave anteriorly.

The human body presents important sexual varieties. The male is taller and heavier than the female; in the former, the central point of the body falls on the summit of the symphysis pubis; in the female, below it. The male is broadest at the shoulders, the female at the hips. The male is remarkable for strength; the female is more feeble, and is distinguished by the fineness of her skin, the little hair upon it, and the roundness of the whole body; the genital organs, however, of the two sexes, present differences to which we shall attend hereafter.

The different races of the human species, also present to the anatomist the subject of curious remarks; their characteristic differences may be considered as modifications of the type, in which the human organism was primitively formed. The principal races are four, the Caucasian, the Mongolian, the Ethiopian, and the American, which is, perhaps, a variety of the second. Their general anatomical differences are deduced from the color of the skin, and from the proportion of the parts. We will only remark that the Caucasian

race seems to be formed in the beauty of the primitive type; the Mongolian and the American are a little removed from this; while the Ethiopian or negro race, differs from it still more.

The individual varieties are very numerous; they refer to the height, the breadth, the more or less vertical direction, and to the symmetry. In the latter respect, the principal general deviation of the human body consists in a complete transposition of the lateral organs, a transposition which Beclard has seen only once in two or three thousand individuals, but which we consider to be less rare; but we cannot state any definite proportion. We have deposited in the cabinet of the faculty, two fetuses, which present instances of it. We have shown another to our class the present year, and have also observed this anomaly twice in the dissecting rooms.

An organization which is so complex and so admirably combined, and which is subjected to laws even in its anomalies, could not be conceived without a continual action which constitutes life;* this action can be only temporary, since the organs which produce it, tend continually to change, in obedience to the law of their evolutions. Human life, like its organs, passes through a certain number of changes. The embryo, which is a few days old, lives by imbibing the fluids which surround it, like the infusory animals; at a later period, the vessels of the placenta are developed, and probably there is an absorption, and the nutrition is more complex; the heart, being annexed to the vascular system, renders the circulation, which was before simple as in insects, much more complicated; before the pulmonary artery is formed, the circulation resembles that of fishes; at a later period it is more analogous to that of reptiles. Respiration before birth, takes place, perhaps, through the skin;† but afterwards it occurs by the lungs. The intellect is developed gradually in infancy, and the nutritive life depends upon it; at puberty, a third order of functions is established, the genital, which sometimes govern the others; during the adult or mature age, man fulfils three orders of functions, which are equally developed; some have for their end his own preservation; the others the perpetuation of the species; at a later period the genital powers are lost, the mental faculties are enfeebled, and the nutritive life alone remains. In following this progressive evolution of the functions, we see that

* To attempt to define life exactly, would be to undertake a thing prematurely, for we ought first to possess all the elements of the question, and the science is far from this. We consider life to be only the organization in action.

† At least the thinness of the skin, and the respirable gas discovered in the waters of the amnios by Lassigny, may lead to this presumption—besides, Edwards, by the finest and most conclusive experiments, has proved this cutaneous respiration to exist in the batracia.

in the fetus, the organs are at first independent in their action, but afterwards become subordinate to each other, and so connected that they cannot act separately. In fact, in the early periods of life, the vessels are sufficient for the circulation without the heart, but when the heart is once formed, if we remove it, the circulation is arrested.

Such is man during his existence, and when his system is regularly developed; but this is not always the case; sometimes the cause of the development is suddenly arrested, although we are unable to account for this curious phenomenon.

Hence the changes which constitute *monstrosities;* changes which may affect parts of the body, or the whole individual. We shall consider them here in this latter respect. The infinite number of stages through which man passes to arrive at the perfect state, measures exactly the infinite variety of these general monstrosities, because the irregular formation always resembles one of these stages;* instances are not wanting in support of this ingenious theory of monstrosities. Is it not because the fetus has been arrested at the commencement of its development, that the semi-organized masses, termed moles, are formed in the uterus? and do not these false developments, when arrested at a later period, cause acephalous fetuses, &c., and leave to certain full grown fetuses some resemblance with the lower animals; giving rise to those trivial but remarkable histories that women have brought forth animals? I am aware that certain monstrosities cannot be explained on this principle, but this only proves that many causes concur to produce these deviations, and it is no reason why the theory should be rejected; in the present state of the science, this conduct would be absurd, not only because the theory of arrested development holds true with most cases, but also because it is connected with the known laws of the organism, and because certain monstrosities could have been produced in no other manner. In other cases, the normal formation of man is deranged in a measure, by an excess of development, and supernumerary parts are formed, or the parts are unusually large.

Such are the general causes which act upon the organism from its beginning; but in order to have a complete idea of these changes, we must add, that female monsters are much more numerous than males; that one deviation often causes another; hence, Beclard has asserted that the absence of a part of the nervous system often

* Animals are subject to fewer monstrosities the lower they are in the scale; because they pass through fewer stages of development, and because the deviations of their organism are for the most part only reproductions of those, and never raise the animal to a higher degree of the organization. In fact, a monstrosity of the bird kind never presents the voluminous brain of a mammal.

prevents the formation of nerves, and consequently of the organs influenced by these in the normal state; the effect, however, may have been taken for the cause; this, at least, would seem demonstrated by the cases mentioned by Serres, who has also cited others, which show that the nerves and their centres of origin are more independent in their formation than has been admitted. The absence of one part consequently causes the absence of the corresponding part of the sanguineous system; the reverse does not seem to be true, as Serres asserts; for the vessels arise in the organs, and never extend to form them. Finally, two organisms are sometimes more or less perfectly united, and what is more strange, one of them may contain the other. Sometimes these anomalies are simple, and are compatible with life; in other cases, they are complex, some of the essential organs are deficient, and the infant dies at birth.

Our organs, when completely formed, are also exposed to numerous diseases, some of which are produced by physical agents, while others result from a greater or less vital derangement; sometimes they are slight, in other cases they are extremely serious, and soon destroy life. Whatever may be their result, they are marked externally by appearances and symptoms which are modelled by the structure of the body, or of one of its parts if the alteration be local. Hence a true pathological physiology, which can be interpreted properly only by anatomy, while at the same time it directs the hand of the physician, in cases where an operation is required to restore the equilibrium necessary to preserve life.

When death supervenes, whether it results slowly, from the alteration of the organs and their functions consequent on old age, or if on the contrary, it cuts off an individual in the prime of life, by an acute disease, all the vital phenomena do not completely and instantly disappear; the heart contracts for a long time, although its power is not sufficient for the circulation; the nerves, also, and particularly the muscles, retain some vitality for a variable length of time. Nysten's experiments have proved that these latter may contract six or eight hours after the respiration and circulation have ceased; this length of time varies, however, with the kind of death. Finally, the muscles contract for the last time, the whole system becomes rigid, and continues so for a greater or less length of time, and decomposition immediately succeeds.

The body, when insensible, preserves a certain expression, which depends on the nature of the death and the sensations which have preceded it; paleness of the face is a characteristic of individuals who have died from hemorrhage; in apoplectics, on the contrary, the face is red and swelled, and the features of those in whom the agony of death

has been long and painful, have also an expression of deep suffering. When dissolution takes place, these characters disappear, but new and very curious phenomena are seen, especially when fermentable matters exist in the stomach; the face and the eyes, which were collapsed, tumefy; the latter become brilliant, and start from their orbits; the eyelids open, and the face assumes a frightful expression.

Chaussier attributes this change to the disengagement of gas in the stomach, by which the diaphragm is crowded up, and consequently the blood is sent to the upper part of the vascular system. Finally, in a very short time, the elements of the body are separated, obey their affinities, enter into new combinations, some proceed into the atmosphere, others remain combined with the ground, and the organism disappears.

The human body is composed of the trunk and extremities, which have a distinct structure and uses; they must be examined in detail.

PART I.

OF THE TRUNK.

The trunk is the splanchnic portion of the body. In our species its length is a little more than half the height of the individual. Its breadth varies, but is much less than the length. The thickness, or the antero-posterior extent is still less; hence the general form of the trunk is flat.

The direction of the trunk may be seen very well posteriorly; it is undulating, projects anteriorly at its two extremities, and is hollowed in the centre. Its size also varies; it bulges above, but becomes smaller at the neck; it again enlarges at the thorax, and then contracts slightly, after which the enlargement of the pelvis follows.

The first section of each limb also increases the transverse measure and the size of the trunk by resting on it, as we shall see hereafter.

Considered externally, the trunk presents a central part and two extremities. It may also be considered according to its four faces; the anterior or *sternal* is flat, and more hairy than the others, presents below a very distinct raphe, but none, or nearly none, above; the limbs arise from the lateral faces, and are nearly blended with them; the

posterior or *spinal* face is marked in its whole extent, and on the median line by a very distinct raphe, situated in a long groove, at the base of which we perceive the series of the spinous processes of the vertebræ, while on the sides are two muscular prominences which are more distinct below than above.

We learn from analogy, and from examining the trunk in man, that it is formed of a certain number of superimposed layers or rings, which, although not exactly similar, as in the inferior animals, are remarkably analogous; in fact each of these segments includes a vertebra, a portion of the cerebro-spinal nervous system, a pair of nerves, and some vessels and muscles which are very analogous.

In the *annelides*, for instance, this analogy is so great, that the description of one of the sections of the body will give an exact idea of the whole individual. In man, however, this is not the case; the trunk is so modified anteriorly and on the sides as to form large cavities, lined by serous membranes, in which the viscera are situated. The rings, however, remain so apparent posteriorly, that it is convenient to examine them in this direction; attending, however, only to their analogies, and deferring the characteristic differences of the regions until we describe them. (*See the posterior cervical, the dorsal, the lumbar, and the sacral regions.*) This posterior face of the trunk, called by Beclard the *great spinal region*, has for a skeleton the posterior or apophysary portion of the vertebræ; the vertebral canal consequently belongs to it, and also the vertebral grooves, which are separated from each other by the spinous processes; this skeleton protects the spinal marrow, which does not descend entirely to the bottom in the adult in whom it seems to be contracted from below upward;* it is enveloped by three membranes; the external is very dense and does not adhere to the bones, as in the skull; it is termed the *dura mater;* the second, the internal, covers the organ directly, the *pia mater;* the last is intermediate, is the true serous membrane, the *arachnoid;* the sacrospinalis muscle is also common to all the points of this face of the trunk; its transverse fasciculi adhere to the bones; the other muscles are superficial, and exist only in certain parts, and will be examined hereafter; the vascular system is also arranged uniformly in every part, it is on the outside or inside of the vertebral canal; on the outside, the lateral arteries of the trunk† send into the vertebral grooves a considerable twig, which is

* This arrangement is established by the arrangement in the fetus, where the medulla fills the whole vertebral canal, by what is observed in all the vertebrated animals where the medulla descends very low, and in man by the origin of the last pairs of nerves from the crural portion of this medulla.

† The lumbar, intercostal, lateral sacral, and the twigs of the vertebral artery.

distributed to the muscles; these same external trunks send inward, through each intervertebral foramen, another twig which follows the corresponding nerve, sends a filament into the body of the vertebra, and another to the membranes of the spinal marrow, while, pursuing its course, it anastomoses with the spinal arteries, which are distributed to this region. Two long veins descend along the anterior wall of the vertebral canal, communicate on the outside with the lateral veins of the trunk, and unite with the internal venous rings, which are equal in number to the vertebræ; others form on the outside a net-work on the vertebræ, and are afterwards united near the intervertebral foramina, with the preceding veins. The lymphatic system follows the direction of the venous; it is little known in the vertebral canal. A pair of nerves formed of two unequal roots,* one, posterior, formed of the filaments of sensation, the other, the anterior, the conductor of motion, emerges from the canal after passing obliquely, but their obliquity and extent gradually increase from above downward; each of these nerves sends behind the vertebra into the muscles, a filament proportional in size to the size of the muscles, but identical in arrangement with them. Some cellular tissue exists within and on the outside of the vertebral canal; the first is more loose than the second, and is found only between the dura mater and the bony walls of the vertebral canal; where, also, the adipose vesicles alone occur. Finally, we remark that the skin is considerably thick in every part where it is depressed by the adhesion which it forms with the summit of the spinous processes of the vertebræ.

Development. The distinct facts which have been collected by a great many distinguished anatomists, Meckel, Tiedemann, Beclard, Chaussier, Blainville, &c., on the development of most of the organs and regions of the trunk, allows us analytically to lay down the general laws of the normal development of the trunk. It is first seen on the umbilical vesicle, its centre or abdominal portion being formed before its extremities, and although it is not demonstrated by direct

* The structure of these veins is very similar to that of the others, while the term *sinus*, which is applied to them, seems to render the idea obscure.

† In this respect anatomists differ very much, and Beclard states that the posterior root is larger than the anterior in the neck, while the opposite is true in the lumbar region. Gall was more correct in saying that the posterior root is always the larger; it was important to determine this point, which has become particularly curious since the experiments ef Magendie. Our researches on this point have determined that the posterior root is to the anterior: in the neck, : : 2 : 1; in the back, : : 1 : 1; in the sacrum and loins, : : 1½ : 1, which agrees perfectly with our knowledge of the functions of the parts to which these different nerves are distributed. Some experiments of Bouvier support the experiments of Magendie, showing the plexiform interlacing, and their division between all the filaments which arise from the common trunk; thus anatomy and physiology will always mutually support each other.

inspection, it would seem that the two lateral segments are at first formed in its whole extent, and that they soon unite, not at their surface, but by a central point, placed on a level with the bodies of the vertebræ; two large grooves are then formed, the anterior, which is deeper, and the posterior; these are the rudiments of the splanchnic cavity, and that of the spine. Next, and this has been observed directly, the two edges of these open cavities increase, meet each other, and unite by a raphe, which appears first above, afterward below, and the permanent marks of which would prove that the progress of nature is such as we have described. The annular form of this part of the body is more apparent the younger the fetus is; the spinal marrow descends at first to the base of the vertebral canal, and renders its different segments more similar; we will add in regard to the special development of its posterior face, that the spinal marrow is formed at first of two distinct cords, which soon unite in one layer, and that it presents a posterior groove, which closes at the back part, and forms a central canal, and is afterwards obliterated by the gray substance; finally, these changes take place at the upper part more quickly than at the lower.

Varieties. The trunk varies very much according to the ages; in the first periods of life, its length equals that of the whole body; it increases absolutely until the age of twenty-five, and at the same time, its size, compared with the whole frame, gradually diminishes; in the first periods, also, the antero-posterior diameter exceeds the transverse; the direction is uniformly that of a curve concave anteriorly; a direction which reappears in the old man, after disappearing through half of life. The different enlargements of the trunk, and the contractions between them are successively formed.

In the female, the length of the trunk is proportionally less than in the male; in the former, the transverse diameter is greatest at the pelvis, in the latter between the shoulders.

All or nearly all the individual varieties of adult age, represent only the normal state of other periods of life, or that of a different sex.

Uses. The trunk forms principally cavities, fitted for the protection of those viscera which are most necessary for individual life; viscera to the functions of which it contributes something by its movements. Slight mutilations of this part by operations are not admissible, and thus many of its diseases are mortal, when they do not yield to ordinary remedies.

Pathological Deductions and Operations. The trunk is not always formed regularly as has been mentioned; sometimes its progress is arrested, sometimes it exceeds its usual bounds; hence occur fissures or abnormal unions, to which we shall attend specially here-

after. From the manner in which the trunk is formed, its extremities may be entirely deficient, while its centre always exists ; and in fact, the development of the individual, and his existence, even when mutilated, supposes this point of the trunk. We have never seen a complete fissure of the whole trunk; but in some individuals the anterior cavities are open on the median line; the same thing has often been seen posteriorly in the cavity of the medulla, the *vertebral canal;* finally, there are cases of fissure of the bodies of the vertebræ, all of which deviations of formation are easily explained by the development of the fetus being arrested, since they resemble the normal states of the embryo. As the formation of the trunk is completed above sooner than below, abnormal fissures are more frequent at the lower part; hence some writers have erred in ascribing as the cause of its usual appearance below, and of spina bifida, the position of the fetus in utero during the early periods of gestation, which position varies very much: as the central canal of the medulla exists only at an early period, dropsical accumulations take place at this time within this organ, while at a later period the serum always collects externally. The muscles of the whole trunk sometimes contract in different kinds of tetanus; the posterior in *opisthotonos*, the anterior in *emprosthotonos*, the lateral on one side in *pleurothotonos*, and finally, all together, in *tonic tetanus*. The position of the spinous processes of the vertebræ directly under the skin, explains the frequency of their fractures and those of their layers, from external violence; the fractures, however, are less frequent, because the processes are situated in the median depression, formed, as has been said, in individuals who are strong, by the sacrospinalis muscles. As the spinal nerves proceed obliquely to a greater or less distance before leaving their canal, we must not, if we wish to act upon their origin, in partial paralyses, employ our remedies upon a point of the region directly on a level with the paralyzed part, but upon a higher part.

The trunk is generally divided into extremities, and a central portion, which we must now study.

SECTION I.

EXTREMITIES OF THE TRUNK.

Of the two extremities of the trunk, one is a spheroid, the head; the other is rudimentary in man, but more distinct in animals, and forms the tail.

CHAPTER I.

OF THE HEAD.

The head is the cerebral extremity of the trunk. It is situated horizontally on the vertebral column, of which it is considered by zootomists as an expansion.

The absolute size of the head is considerable. Its external face is covered with skin forward, backward, upward, and on the sides; below, on the contrary, it has no relation with the skin, but joins the neck with which it is blended; its internal face forms cavities, which protect the upper expansions of the cerebrospinal axis, and the principal organs of the senses.

Development. The head is not at first distinct in the ovoid mass of the very young embryo; afterward, it is separated from the rest of the trunk by a circular contraction which indicates the neck; if we except the commencement of fetal existence, its proportional size is greater, the younger the fetus is; its structure then is not perceptible; its size depends on that of the cranium, as the face is very small: at a later period, the structure of the face is more advanced than that of the cranium; thus at these two different periods, the size and development of these two parts have opposite relations. The protected organs are formed first, the protecting parts afterward, and their development is always secondary to that of the former. The head is formed, and

the trunk also, of lateral parts which unite on the median line; the division continues longer in the bones than in the soft parts.

Varieties. The head presents numerous individual varieties of sexes and races, which are mentioned minutely in all works on descriptive anatomy; we will only state, that the posterior part of the head in the female, is developed much more, proportionally speaking, than in the male.

Pathological Deductions and Operations. The absence of the head in the first period of fetal existence explains its absence in certain full grown monsters; this defect constitutes acephalia, which must be distinguished from anencephalia, which we shall mention hereafter; farther, the head alone may be deficient, this is simply acephalia; it may be absent with a greater or less portion of the trunk, as we shall mention hereafter. Acephalia is attended with numerous anomalies of the viscera of the trunk, because, as Beclard states, an organ is deficient when its nerves do not primitively exist.

The head is one of the most important parts, and although the fetus may exist without it while within the uterus, it is necessary to extra-uterine life, because this portion of the trunk contains the organs which direct the contractions necessary for respiration, and when this agent is deficient, respiration cannot take place; the removal of the head also causes death, because it removes the respiratory principle.

The head comprises the cranium and the face; parts which are distinct in every respect.

ARTICLE I.

OF THE CRANIUM.

The cranium is the cerebral portion of the head; it has an irregular oval form, the great extremity of which is posterior; it is situated at the upper and back part of the head, and forms that part which is directly continuous with the spine; its direction is horizontal in man, and oblique to the horizon in animals; its absolute size varies much; its proportional size is always inversely as that of the face.

The external surface of the skull is loose and covered with skin, upward, forward, backward, and on the sides; below it is blended with the neck and the face. Its inner surface is in contact with the nervous

system, is lined with the parietal fold of the arachnoid membrane, and is more or less prolonged by septa.

Structure. The cranium is formed of bone, and is covered with two periostea, the external of which is thin, while the internal is more developed; the soft parts are situated on the outside, and vary much; they give rise to numerous veins termed the *emissary*, which have a very curious arrangement, of which practitioners take advantage in treating diseases of the brain or of its membranes; these vessels have no valves, their radices are situated on the outside of the skeleton of the cranium, and unite in trunks, which continually increase; they pass through the sutures or the venous foramina, and go directly into the meningeal sinuses, into the meningeal, or the diploic veins. The great arterial trunks, which are distributed in the cavity of the cranium, send twigs to the outside, towards the organs of the senses, which connect the circulation of the latter with that of the cranium; they are also remarkable for their broad anastomoses.

Development. To the general development of the head, we must add, when speaking of the cranium, that it forms first at its base, that its arch is completed the last; the fontanelles, the traces of this slow formation, continue for a long time. The numerous varieties of the head, which have been mentioned before, are manifested particularly in the skull.

Pathological deductions and operations. The whole of the skull is sometimes deficient: this deformity is termed by Becard *acrania;* sometimes its base only exists: this is called *anencephalia;* this monstrosity was for a long time confounded with acephalia, but it is perfectly distinct and causes fewer anomalies in the internal viscera. Most authors think, that anencephalia is produced accidentally by a disease which destroys the mass of the brain during fetal existence, and at the same time arrests, or prevents the development of the upper parts of the skull after the base was formed. Finally, in some cases, the arch of the cranium is formed, but always remains separated to a greater or less extent; hence arise hernia of the encephalon. The arrangement of the emissary veins shows the possibility of acting powerfully on the internal parts, and particularly by a retrogade motion of drawing blood directly from the meningeal veins. The general arrangement of the arteries accounts for external swellings, and for the affections of certain organs of the senses, in internal inflammations.

Such are the general ideas furnished by examining the cranial portion of the head; in order to be acquainted with it more minutely, we must examine successively the parietes of its cavity and its cavity.

PARAGRAPH FIRST.

PARIETES OF THE CRANIUM.

Anatomists number six parietes of the skull, the upper, the lower, the two lateral, the anterior, and the posterior: but it is more convenient for the study of this part of the skeleton, to divide the cranium into an arch, (which includes the upper, the anterior, and the posterior parietes,) and into the lateral and inferior parietes. The first are unattached; the last is blended with the face and the neck, and we shall also see its relations with the ocular, olfactory, zygomatic, pharyngeal, and nuchal regions. Farther, the following table will give an idea of this division of the parietes of the cranium into two regions.

CRANIUM.	Unattached portion.	Arch.		1. Occipito-frontal region.
		Lateral parietes.	Forward.	2. Temporal region.
			In the centre.	3. Auricular region.
			Posteriorly.	4. Mastoid region
	Attached portion.	Lower wall.		5. Region of the base of the skull.

ORDER FIRST.

ARCH OF THE CRANIUM.

The arch of the cranium constitutes a very simple region, the *occipito-frontal*, which is formed in every part of the same layers; the termination of the hair forward is not a sufficient reason for forming a frontal region; it is still less convenient to form a parietal and an occipital region; this would expose to frequent, vexatious and useless repetitions.

OCCIPITO-FRONTAL REGION.

This unmated and symmetrical region extends from behind forward, from the external occipital protuberance and a line drawn from this point to the mastoid processes, to the nasal protuberance and the eyebrows; on the sides, the termination of the hair separates it posteriorly from the mastoid and auricular regions, while it is distinguished anteriorly from the temporal region by a curved line which exists on the bone, but is not seen externally; one extremity of this curve rests on the external orbitar process, the other on the root of the zygomatic process, and forms a semi-circumference, the diameter of which is represented by the last process. These limits are all natural and are easily determined. This region has the form of an arch; it is sometimes termed the *arch of the cranium*. Its thickness varies from many causes,

which will be mentioned; in the adult its mean thickness is half an inch. The occipito-frontal region presents two faces; one is cutaneous, the other serous; the first is convex, and covered with *hairs* posteriorly: anteriorly, on the contrary, for a quarter of its length it is nearly smooth; these hairs cover the posterior three fourths of the region; their directions vary. Posteriorly, the hairs pass beyond this region, and advance toward the neck; anteriorly, they suddenly terminate in a variable line, which determines the height and certain forms of the forehead, while its different degrees of inclination depend on the skeleton; this line is sometimes a simple curve concave anteriorly, sometimes it presents a convexity, and two semi-circles; an arrangement generally considered as the most beautiful. Forward, and on the outside, the hairs are extended on the temples, but on the outside and backward, they terminate in a curve which embraces the auricular and mastoid regions; between them, are the orifices of numerous sebaceous follicles. The hairs vary very much in number, size, and direction; sometimes they are very straight, sometimes very curly, and frizzled; this latter state exists in the greatest degree in the negro; their color varies from white to the deepest black; their length is determined by custom; in a state of primitive nature, however, they descend to the lower part of the trunk, and their growth then ceases, or it is very much retarded; on the contrary, when cut before this time, their growth is rapid, and very thick. The smooth part of this region, the *forehead*, presents the frontal protuberances, and a depression below.

The serous or cerebral face of the arch is smooth, and constantly moistened with serum; the large falx of the dura mater arises from it in the centre, and the tentorium posteriorly, on a line drawn between the mastoid processes and the external occipital protuberance.

Structure.—1. *Elements.* This region is composed of but few parts; its resistance is caused by a skeleton formed by the upper part of the frontal and nearly all the surface of the parietal bones; these parts are united by the sagittal sutures, and sometimes by the median suture of the frontal bone, the occipito-parietal or the lambdoidal, and the fronto-parietal sutures. This arch presents the parietal foramina in the centre, and on the inside, the frontal crest anteriorly, the longitudinal groove, posteriorly; its thickness varies much, according to the ages; in the adult, its mean thickness is four lines; it is greater anteriorly, on the median line, at the frontal crest.

The external and internal periostia pass over the sutures, adhere to them and strengthen them much. The external periosteum, the *pericranium*, presents nothing remarkable; the internal periosteum, the *dura mater*, is extremely strong, and contains within it two sinuses, the upper longitudinal and the lateral; on a level with

the union of the latter, the torcular Herophyli: this latter is situated on the external and occipital protuberances; the others at the base of the imperfect septa, which are sent from the inner face of this region into the cavity of the skull, one consequently on the median line, the other between the mastoid processes, and the external occipital protuberance. The occipito-frontal muscles, and their aponeurosis occur here; this latter forms a complete covering for the head, *galea capitis*, which it follows even upon the temples, and which, with its muscles, is very important in this region. The cellular tissue is very rare and dense on the inside of the bones; on the outside, it is lamellar and very loose below the occipito-frontalis muscle, while the opposite is true above it. Fat occurs only in the latter point, and but little exists there.

The arteries of this region are anterior, posterior, or lateral; some are situated on the outside of the skeleton, others are deep seated; among the first, the *anterior* emerge from the orbit, and are given off by the supraorbitar and frontal branches of the ophthalmic artery, which comes from a cerebral trunk; the *posterior* are twigs of the occipital artery, which also emerges from the nucha; finally, the lateral are given off by the two branches of the temporal artery and by the posterior auricular artery, all of which anastomose. Among the second, the anterior, the *anterior meningeal* belong to the ethmoidal arteries; the posterior to the occipital, the inferior pharyngeal, and the vertebral artery; they are called the *posterior meningeal* arteries; the lateral to the *middle meningeal* artery. The veins generally follow the course of the arteries, except the frontal vein, which, however, to a certain extent represents the course of the frontal branch of the ophthalmic artery; it is rather large, and it is often very visible externally; small emissary veins are situated at the sutures, particularly two, which are large at the parietal foramina, on the top of the region. The internal lymphatic vessels are not known; Mascagni, however, states that he has seen some in the dura mater; those which arise externally, form two very large lateral fasciculi, which follow the temporal and posterior auricular arteries, and go to the parotid and mastoid ganglions; a posterior fasciculus follows the occipital artery and goes to the substernomastoid ganglions; finally, a small anterior fasciculus accompanies the frontal vein, descends to the face, and goes to the submaxillary ganglions.

The nerves are anterior, posterior, and lateral, like the vessels; the first leave the orbit, and are the twigs of the supraorbitar nerve; the second come from the nucha and are the posterior branches of the first cervical nerves; finally, the last are filaments of the facial nerve,

of thesuper ficial temporal,of the inferior maxillary, and of the mastoid nerve of the cervical plexus.

Finally, the skin and the parietal fold of the arachnoid membrane complete all the elements of this part.

2. *Relations.* The relations of the occipito-frontal region are extremely simple; the layers are uniform in every part; the first is formed by the skin, which is dense and presents numerous follicles; the second layer is composed of a very dense cellulo-fatty tissue, forming bands which intimately connect the skin with the subjacent layer; in the centre are all the external vessels and nerves; the third layer is formed by the occipito-frontal muscles, and the epicranial aponeurosis. A very loose lamellar tissue forms the fourth, and unites the preceding to an external periosteum, which adheres very firmly to the sutures and the parietal foramina, by means of the emissary veins and fibrous prolongations which come from the dura mater; next, the bones form a firm, distinct, and solid layer, which is thickest anteriorly on the median line, where the internal frontal crest exists. Below, the internal periosteum presents itself, the *dura mater*, the adhesion of which varies with the age, and is always firmest at the sutures and at the parietal foramina; it contains in the places mentioned, the superior longitudinal sinus, the torcular Herophyli, and the lateral sinuses; the parietal fold of the arachnoid membrane adheres to it very firmly, and terminates the region on the inside.

Development. In its development the arch of the cranium presents four distinct periods, which are observed in the bones better than in the soft parts. 1. The region is completely separated on the median line; 2. Next the soft parts unite, the bones still preserving marks of their primitive separation, the median *fontanelles;* the anterior of these is quadrilateral, the posterior is triangular, both are important in obstetrics; 3. In two years the fontanelles disappear, the sutures are all perfectly formed, and the arch of the cranium is less liable to be injured by external violence; 4. In old people the sutures disappear, the emissary veins which pass through them are effaced and change into fibrous filaments, the parietes of bone become thinner, uniformly in every part, or in certain points, and generally near the parietal bones; this diminution, termed *senile atrophia*, depends on the absorption of the diploe, and sometimes exists to such a degree, that the cranium is perforated; in this case the skull is always very weak, the external table constantly approaches the internal, which remains moulded on the cerebrum. In the fetus and the young child, the external periosteum is separated from the bones by a thin layer of cartilage for their increase in thickness, and adheres very slightly, while the dura mater is attached firmly; in the adult, and particularly

the old man, the dura mater, on the contrary, adheres slightly and the periosteum firmly. As age advances, the frontal sinuses sometimes extend into every part of the forehead.

Varieties. The arch of the cranium presents numerous varieties; they always depend on the bones, which are moulded on the encephalon; when the latter is very much developed anteriorly, the region is very convex in this direction. This development, which generally marks the Caucasian race, varies however very much, and is usually connected with great intellectual faculties; on the contrary, a large transverse diameter and a considerable prominence posteriorly, a development caused by the size of the brain in this part, is considered by some physiologists, particularly Gall, as indicating a great development of the genital powers. This region sometimes rises very high, as in conical heads.

Pathological Deductions and Operations. The entire absence of this region, or its rudimentary state with a broad median separation, characterizes an encephalia; when it is partially cleft, it exposes, as we have already seen, to hernias of the encephalon, which sometimes supervene accidentally after fractures of the bones with loss of substance, or after senile atrophia, which has left a broad perforation; these hernias form tumors which are remarkable for their pulsation and for the drowsiness caused by their compression. The ancients attributed the severity of wounds in this region to the lesion of the cranial aponeurosis, entertaining the false idea that this white part is nervous; these wounds, wherever they may be, are serious; first, because some nerves are affected very near the centre of the nervous system, toward which the pains proceed: second, because they often cause an inflammation which extends by the continuity of the vessels to the meninges: third, because the frontal vessels arise from trunks which are also distributed to the brain, and although the irritation caused by these wounds solicits the blood into their external branches, the circulation in the internal branches is quickened by the same cause, and disposes to cerebral affections: fourth, finally, besides the shock which is often communicated to the encephalon in these cases, fractures and internal effusions may supervene, and require serious operations.

The physical injuries of the arch of the cranium consist in more or less complicated wounds; they may occur without wounds: in the first case, a severe pain sometimes results from the partial section of a nervous filament; it disappears when the filament is completely divided: hemorrhage is never a severe symptom; the arteries, however, situated in a very dense tissue, are difficult to tie; we have experienced this after extirpating an erectile tumor, developed upon the posterior part of this region, an operation which we performed last

year with great success. In wounds of the integuments, the occipito-frontalis muscle is often completely separated from the pericranium, as we may readily conceive from the looseness of the cellular tissue which unites these two parts. The pericranium also may be separated, and the bones be fractured with or without depression; if the wounding instruments proceed farther, the two meninges may be affected, as also the upper parts of the brain, which are protected by this region. The fractures of the skull do not necessarily agree in place with the lacerations of the soft parts; farther, a blow upon this region does not necessarily fracture its skeleton; from the known mechanism of the cranium, this blow may affect the part, near the base of this cavity, and fractures at a greater or less distance from it, may supervene. Fractures are generally attended with the separation of the two periostea, and with effusions which vary in their situations, as we shall see hereafter; farther, it is important to remember the direction of the sutures, in order not to confound them with a simple crack. When the frontal sinuses are very much developed, and extend into this region, their anterior wall, if depressed, may resemble a very serious fracture. When this region is injured, effusions of blood often supervene; they may be external or internal; when *external*, they are generally situated between the skin and the occipito-frontalis muscle, and are very slight, on account of the density of the cellular tissue, which does not allow them to extend far: the position of the vessels under the skin in the cellular tissue, explains the situation of these collections; sometimes, but rarely, we find a little blood under the occipito-frontal aponeurosis; it is infiltrated to a distance, and never forms a tumor; when these effusions are *internal*, they most generally occur between the bones and the internal periosteum which is separated, and are then confined to this place of separation; they result most commonly from the lesion of the emissary veins,* but they may also exist in another part, which is generally but little known; they sometimes form between the dura mater and the parietal fold of the arachnoid membrane, which in this place are intimately connected; Rostan relates an instance of it in his excellent work on the softening of the brain; and at the hospice Bicetre, we examined a deranged person, who presented one at the parietal fossa of the right side. It existed between the separated dura mater, and the arachnoid membranes: we were told that this effusion supervened after the unfortunate battle of Waterloo, in which this man, a soldier in a regiment of the line, received a violent sabre blow on the head in the

* We examined with Cambournac, an individual who had died in consequence of an effusion, where the blood came from the middle meningeal artery, which was injured by a spicula of bone.

point corresponding to the effusion: this old injury was perceived at the examination by a broad cicatrix existing on the soft parts and in the bones which had been injured. The effusions are always confined within very exact limits; finally, others may occur more deeply in the skull; we shall speak of them hereafter. Of the effusions of blood in the region of the arch of the cranium, those which are formed between the bones and the dura mater, or between the dura mater and the parietal arachnoid membrane, may rationally require trepanning; because, as we have seen, they are circumscribed, which may be recognized by a very distinct paralysis of one side of the body. When the injuries of the arch do not destroy the patient immediately, they often cause collections of pus, some of which are external, others internal; the first are circumscribed and slight, and appear between the skin and the epicranial aponeurosis; or they are formed under this latter, and are then diffuse and very serious, and must be evacuated early; the second are always circumscribed; they occur on the outer surface of the dura mater, and are frequently fatal. Caries, and necrosis of the skeleton of this region are not rare, being caused particularly by syphilis, which also gives rise to exostoses; necrosis supervenes only when the disease acts on the pericranium; the whole thickness of the bone is then separated at the same time, and it is curious that it is never reproduced; the dura mater does not take the place of the internal periosteum, except to a certain extent and it differs from the periosteum of other places in not reproducing a new bone; the reason of this is, that it sends, in fact, few vessels into the bones, which are nourished principally by the pericranium. Encysted tumors often appear in this region; these are real follicles, developed after the obliteration of their neck; these tumors are flattened on account of the firmness of the skin, and are always situated on the outside of the epicranium; they are easily extirpated when recent; but if old, this is not the case, because they adhere firmly to the deep layers. Inflammation of the skin is very painful, because its internal adhesions prevent its yielding; it is generally followed with the loss of the hair. This inflammation is sometimes of the nature of erysipelas, and sometimes affects the follicles or the bulbs of the hair, and forms the mucous exudations of children, and the different kinds of tenia: in all these diseases there is an engorgement of the anterior, posterior, or lateral lymphatic ganglions, in fact of those to which the lymphatic vessels from the diseased part go. A peculiar affection of the papillæ of the hairs, causes a singular matting of the hairs, marked in *plica polonica,* in which disease the hairs are said to become vascular, and to bleed when they are divided. The fact is, that the blood does not come from the hairs themselves,

but from their papillæ, which are elevated above the level of the skin, from the infundibuliform cavity of the root of the hair, in the same manner as blood flows from the papillæ of the plumes of the young bird, when they are divided near the skin, and not from the plumes themselves. This region is the place selected for trepanning, which should not be performed upon the sutures, in order to avoid the emissary veins which pass through them; nor on the median line, to avoid the superior longitudinal sinus, the frontal crest, &c. This advice is very good, but should not be followed too strictly, for these accidents can be avoided. We have already mentioned the convenience of this operation in some cases; we shall return to the subject hereafter: trepanning is most indicated in cases of fracture with depression, when symptoms of the compression of the brain appear.

ORDER SECOND.

LATERAL WALL OF THE CRANIUM.

This wall is formed by three small, simple, and distinct regions; the temporal, the auricular, and the mastoid regions.

1. TEMPORAL REGION.

This region forms the anterior portion of the lateral wall of the cranium; it is bounded forward by the external orbitar process of the frontal bone; backward by the root of the zygomatic process, and by the auditory passage; downward by the zygomatic arch; and upward by a curved line concave downward, called the *temporal*, which line has already been mentioned, when speaking of the preceding region.

The temple is flattened transversely, and its plane is nearly perpendicular; it is thicker than the occipito-frontal region, but its thickness varies in different parts; it is stronger below than above, and anteriorly than posteriorly; its mean thickness anteriorly, directly above the zygomatic arch, is twelve lines; posteriorly, it is only six.

The temple presents two faces, one cutaneous, the other serous; the first is covered posteriorly with hair, but anteriorly, it is continuous with the forehead, and increases its transverse extent; its lower part is convex in children, but in the adult, on the contrary, it presents a slight depression, which marks the zygomatic arch, and which is deeper the thinner the individual is; the serous face presents nothing remarkable; it is smooth, moist, and rests on the cerebrum.

Structure.—1. *Elements.* The elements of the temple are few; it owes its principle resistance to a skeleton formed of the squamous part of the temporal bone, of portions of the parietal, of the frontal, of the

great wing of the sphenoid, and of the malar bone; these pieces are united by the squamous, the spheno-temporal, the spheno-parietal, and the sphenoidal sutures, and by those which join the malar bone to the frontal and sphenoid bones, and to the zygomatic process. This osseous surface is thin and transparent above; on the inside, it forms in the adult for the middle meningeal artery an osseous canal, which is situated as high as the external orbitar process, and two fingers' breadth behind it; on the whole, the skeleton of the temple is thinner than that of the preceding region, its external and internal periostea adhere to it more firmly, because there are here more sutures which are united to each other by fibrous bands and emissary veins; the temporalis muscle fills the whole temple from its upper to its lower boundary, we also find there some fibres of the attrahens aurem and the attollens aurem muscle. The occipito-frontal aponeurosis is extended to it, and there forms a superficial fascia; a very strong fibrous layer covers the temporalis muscle, and concurs with the temporal bones to form a channel which opens downward only; this layer is attached to the whole circumference of the temple, and is free from adhesions on the outside; on the inside, on the contrary, it serves for the insertion of the external fibres of the muscle; it is single above, and separated below into two layers, which embrace the zygomatic arch, and terminate on its external and internal faces, leaving between them above a narrow triangular space; the two opposite faces of the region are covered, one by a very follicular and partially hairy skin, the other by a portion of the parietal arachnoid membrane. The internal cellular tissue is very dense, as in the preceding region; the external is not abundant, it is dense especially under the skin. It is rarely found in the subcutaneous tissue; it constantly exists, however, between the two layers of the temporal aponeurosis, and more deeply, on the inside and in front of the temporalis muscle.

The arteries of the temple are situated on the outside or inside of the skeleton; the internal are given off by the trunk of the middle meningeal artery, which is situated in the osseous canal mentioned above; the first, on the contrary, are superficial, middle, and deep; the superficial are, the trunk of the temporal artery and its two branches at their origin; the middle are given off by the preceding trunk, and are situated between the two layers of the temporal aponeurosis; the two deep arteries are branches of the internal maxillary; all these arteries anastomose together, and the deep arteries communicate directly with the orbitar arteries, by twigs which pass through the malar foramina; this connection between the arterial system of these two points of the body deserves to be noticed; it has often been implicated in diseases of the orbit. The veins follow strictly the course of

the arteries, except the numerous emissary veins which pass through the sutures.

Some of the lymphatic vessels proceed superficially, others deeply, into the parotid ganglions; a great number come from the occipito-frontal region.

The nerves are superficial or deep; the first are given off by the facial nerve, and the auricular filament of the inferior maxillary nerve; the second are also branches of this last.

2. *Relations.* The relations of the temple are very simple; the first layer of it is cutaneous, as in almost every other part; the second is formed by cellulo-fatty tissue, in which the nerves and superficial vessels of the region are situated. We remark that the trunk of the temporal artery divides there, fifteen lines above the zygomatic arch, that it is situated four lines from the auditory passage, and that on leaving this division, its anterior branch curves forward toward the forehead, the posterior backward to the nucha. The third layer is formed by the attollens aurem muscle and the occipito-frontal aponeurosis, to which it adheres. A very loose cellular tissue separates this layer from the following, constituted by the temporal aponeurosis, forming below by its two layers a triangular space, in which an adipose button of variable size and the middle temporal artery are situated. The temporalis muscle forms a deeper layer in which is also found a mass of fat, and which contains in its thickness near the bones, the deep temporal vessels and nerves. Finally, when all these parts are removed, the pericranium is exposed, and its adhesion may be demonstrated at the sutures. The bones then appear, and under them the middle meningeal artery in the position already mentioned, the dura mater, and then the arachnoid membrane, which is intimately united to the former.

Development. The resistance of the temple is at least as great as that of the occipito-frontal region; the thick layer of the soft parts which cover it, more than compensates for the thinness of its skeleton; this resistance and this thinness, however, are by no means the same at all periods of life; in the fetus and even six months after birth, the bones are not completely united; but a membranous space exists between them anteriorly, which is termed the *anterior* and *lateral fontenelle.* After birth, this region bulges much from two causes; first from the fat, especially that situated between the two layers of the aponeurosis, second from the slight prominence of the zygomatic arch.

Varieties. The temple varies much, presenting a very marked depression or convexity, according to the degree of emaciation or the quantity of fat; these varieties are caused also by the wasting or

development of the fat situated between the two layers of the temporal aponeurosis.

Pathological and Operative Deductions. Wounds of the temporal region, even if not very deep, may be attended with a profuse hemorrhage, especially when they are situated near the auditory passage; this accident, however, is by no means serious, and the temporal artery which is wounded in this case, is easily tied; contused wounds or simple contusions are attended with effusions of blood under the skin, between the two layers of the temporal aponeurosis, and on the bones, against which the deep temporal branches are ruptured; the centre of the bone is protected from fractures by its deep situation and by the temporalis muscle; its circumference, on the contrary, formed by the orbitar process and the zygomatic arch, is situated superficially and projects very much; it is thus naturally exposed to violence and is often fractured; the base of the temple, however, is sometimes broken, notwithstanding its advantageous situation; these fractures are generally produced by counterblows, the orbitar arch having been alone affected. In these cases, circumscribed effusions often form between the dura mater and the bones; we have already mentioned one case where the middle meningeal artery was wounded by a spicula from their internal table. Fungous tumors of the dura mater appear here more frequently than in any other point excepting the preceding region. Encysted tumors containing hairs which are inserted on the parietes of the cyst are often developed at the anterior part of this region near the eyebrows; they are formed by the development of follicles, and the hairs which are found in them belong to the eyebrows, from whence they have deviated. We have seen the whole temple raised by a fungous tumor, which leaving the maxillary sinus, passed through the zygomatic fossa and came to the temporal region. The operation of trepanning should never be performed upon this region, unless it is absolutely necessary; the thickness of the external soft parts is a sufficient reason for this precept. It has been advised also not to perform the operation anteriorly lest the middle meningeal artery contained in its bony canal be injured; our remarks show at what part this accident can happen; in an urgent case, we may trepan even on this point, certain that the hemorrhage may be arrested by introducing a piece of cork through the hole in the bone; in order to preserve those fibres of the temporalis muscle which converge downward, it has been advised in trepanning on the temple, to make the external incision in the form of a V, so as to obtain a triangular fold, the base of which is uppermost, and which should be dissected so that only the point adhered; this advice is good. Leeches and moxas

may be placed with advantage on this region in diseases of the eye or of its appendages; the nervous and particularly the vascular communication which we have demonstrated between these two points, confirms the propriety of this choice. Moxas should not be placed near the ear for fear of wounding the trunk of the temporal artery, which happened in one case, where hemorrhage supervened, which could not be arrested except by tying the vessel above and below the wound.

2. AURICULAR REGION.

The external portion of the organ of hearing is situated in the lateral wall of the cranium, and the internal in the lower wall; they form a region which is very complex and very important. It is minutely described in works on descriptive anatomy; hence we shall refer to them for the details, and shall merely review the most important points, and state the most prominent pathological changes and operations.

The auricular region is formed by nature for a physiological purpose, and is composed of three parts, an external, the true acoustic trumpet, a middle portion, which is designed to insulate on the inside a membrane, the vibrations of which, rendered weaker or stronger by a special apparatus, are intended to make an impression on a tense band situated in the tortuous cavities of which the last part is formed.

The external ear is composed of the pinna and of the auditory passage; the latter particularly, is bounded above by the temporal region, forward by the parotid region, and backward and downward by the mastoid region, from which it is separated by the mastoido-auricular fissure.

Passing over the depressions and prominences which exist in every part, the pinna is formed by a fine skin, which is hairy in some parts, and has numerous follicles; it is united by a very dense cellular tissue to the membranous cartilage which forms the skeleton of this part, and presents grooves filled with fibrous tissue. The special muscles of the pinna are so rudimentary in man, that they are unimportant, especially in topographical anatomy.

The auditory passage is from ten to twelve lines long: it is directed inward and forward, and is curved so that its axis is convex upward; it is broader at its extremities than in its centre; its perpendicular diameter is more extensive than the transverse, and commencing at the bottom of the concha, terminates suddenly inward by a septum, which separates it from the cavity of the tympanum; this septum is formed by three parts; by skin on the outside, by the mucous membrane of the tympanum on the inside, and in the centre by the mem-

brane of the tympanum on which the handle of the malleus rests posteriorly, forming one of its upper expansions. This septum is oblique downward and inward, so as to increase the length of the lower wall of the auditory passage; it sometimes presents an opening caused by an accidental injury, which establishes a communication between the auditory passage and the cavity.* The inner half of this passage has an osseous base; the outer half is cartilaginous and membranous; it is cartilaginous and more resisting forward and downward, membranous and feeble upward and backward: its cartilage is continuous with the tragus, and presents two or three grooves, called the grooves of Santorini, which are filled with ligamentous tissue. The upper and posterior membane is fibrous, and unites the two edges of the cartilage; a prolongation of the skin of the concha lines the whole passage, forming a cul-de-sac on the membrane of the tympanum; this skin is fine, and very follicular on the outside, and is united to the skeleton by a very dense cellular tissue, and contains at the upper part, near the base of the passage, the laxator tympani muscle.

The vessels and the nerves of the external ear are capillary; they are not, consequently, of much importance; some are anterior and others posterior. The anterior arteries arise from the temporal artery, the posterior from the posterior auricular artery; the veins attend the arteries; the anterior lymphatics go to the parotid ganglions, the posterior to the mastoid; the anterior nerves are given off by the superficial temporal filament of the inferior maxillary nerve, and the auricular nerve of the cervical plexus: the posterior by the mastoid nerve of the same plexus, and the auricular branch of the facial nerve.

The middle ear, or the cavity of the tympanum, is situated between the auditory passage and the internal ear: it is separated from the former by the triple septum mentioned above, and from the second, by a wall of bone, on which it rests; the fenestra ovalis, the promontory, the fenestra rotunda, and its canal, are well described by Ribes, who has proved that the membrane of the fenestra rotunda mentioned by authors, is situated on the tympanum higher than they state, and leaves exposed on the side of the cavity, the end of the spiral septum

* We do not mean to say that the membrane of the tympanum does not present an opening, as Rivinus and Scarpa assert. We have ascertained that one exists constantly at the upper part, formed by the edge of the membrane and the frame in which it is inserted: it gives passage to the tendon of the laxator tympani muscle. This anatomical fact is generally badly understood, because the terms, *membrane of the tympanum*, and *septum* of the base of the auditory passage, are confounded. But this opening does not establish a communication between the auditory passage and the cavity of the tympanum.

of the cochlea, in the point where this is inclined downward, to form the lower wall of the vestibule;* upward, the middle ear corresponds to the region of the base of the cranium, and receives through a fissure some arterial filaments from the dura mater; below, it also presents openings for the nerves and vessels; posteriorly, it corresponds to the cellules of the mastoid region, which presents there a common opening, situated above the aqueduct of Fallopius, of the pyramid, and of the foramen, through which the cord of the tympanum emerges. Anteriorly, the cavity is continuous with the pharynx, by means of the Eustachian tube, which slopes at its two extremities; it is osseous, in the side of the cavity, and cartilagino-membranous inward, while its direction is oblique forward, downward, and inward, from the tympanum toward the pharynx; it establishes the communication between the mucous membranes. Above this passage is a groove, through which the tensor tympani muscle passes, and the fissure of Glaser, through which pass to the outside the cord of the tympanum and the tendon of the laxator tympani major muscle. Farther, the middle ear is traversed from without inward, by a chain formed of four little bones, the malleus, the incus, the os orbiculare, and the stapes, which chain unites the membrane of the tympanum and the fenestra ovalis; it is perforated from behind forward, by the superior filament of the vidian nerve, which is adapted to the malleus and to the membrane of the tympanum in its upper half, and finally, it is covered by a very fine fibro-mucous membrane, which is continuous with that of the throat, and with the mastoid cellules.

The internal ear is situated between the middle and internal auditory passage; it is composed of the vestibule, the cochlea, and the semi-circular canals; the *vestibule*, besides its communication with the internal auditory passage, presents the opening of the fenestra ovalis, that of the vestibular portion of the cochlea, the five openings which terminate the semi-circular canals, and that of the aqueducts of the vestibule: it is a central cavity, the lower wall of which looks forward and outward, according to the remarks of Ribes, it is formed by an osseo-membranous prolongation of the septum of the cochlea, the prolongation which is seen at the base of the canal of the fenestra rotunda. The cochlea is situated forward, and is disposed so as to measure by its horizontal axis, the distance between the base of the auditory passage and the carotid canal: it is composed of two slopes which communicate superiorly; one, termed that of the tympanum,

* It follows from these curious researches, that the cavity of the vestibule may receive the vibrations of the membrane of the tympanum through the fenestra rotunda and its canal: this arrangement shows, also, that the membranous part of the septum of the cochlea may be made to vibrate directly by the oscillations of the membrane of the tympanum.

and terminates in the canal of the fenestra rotunda, from which it is separated by a membrane similar to the tympanum, a membrane near which commences the aqueduct of the cochlea; the other, the vestibular, is shorter, and terminates in the vestibule; they are separated by a septum, which is osseo-fibrous at the base, but membranous only at the summit. Farther, this septum describes two and a half spiral turns around the axis, near which it is bony; and this axis is grooved with a cavity dilated outward into the form of a tunnel. The three semi-circular canals, which are placed posteriorly, open into the vestibule by five foramina; one only is common to the two vertical canals; the anterior opening of the horizontal canal, and the separate openings of the vertebral passages, are dilated. The whole internal ear is lined with a very fine and very vascular periosteum; the vestibule, particularly, contains two small sacs, one of them is spherical and distinct, the other is larger and common, and receives the extremities of tubes placed in the semi-circular canals, which are dilated in places where their skeleton is enlarged. The membrane of the vestibule penetrates the cochlea in the same manner. All these cavities contain nervous expansions, which float in the liquid of Cotugno, and are surrounded by some bubbles of air, as Ribes has demonstrated; this arrangement allows the membranes of the internal ear to vibrate, without injuring the nervous pulp. The internal ear is connected by its circulation with the cerebrum, and its principal artery comes from the basilar.

Development. The development of the auricular region is indicated by numerous changes in its different portions; first, there is no external ear, the tympanum looks downward, and is even with the head, as in many animals; the pinna next appears, but it is perfectly flat; in two months, its depressions and prominences, which are so distinct in the adult, begin to appear. At a later period, the short auditory passage is entirely membranous, and the tympanum is very oblique; the latter soon rises, and the ossification of the passage commences at the cavity of this tympanum. It is not, properly speaking, until after birth, that the bony part of the auditory passage extends a little; at twenty-five years it equals the membrano-cartilaginous part, and afterward exceeds it in length.

The middle ear is at first very small; it does not extend into the mastoid region; the Eustachian tube is entirely membrano-cartilaginous. After birth, the osseous part enlarges at the expense of the first, but is never equal to it: the little bones are formed at the third month; a little earlier than this, the ossification of the tympanum has commenced around the fenestra rotunda, which first looks outward, then is directed backward, after the promontory is formed, and is

again directed outward, when the mastoid process is developed: this part, also, is filled until birth with a whitish mucus.

The internal ear is at first only membranous, then cartilaginous before the third month of fetal existence, at which period ossification commences; farther, the whole ear obeys this general law of development, that the protecting parts appear after those which are to be protected.

Pathological deductions and operations. The ear presents numerous anomalies, such as the flattening of the pinna, or the very great prominence of some of its eminences, the absence of the lobule or its adhesion with the skin, the shortness, narrowness, and obliteration of the auditory passage. The membrane of the tympanum is very oblique, and is directed downward in monsters which have no face; we have seen two external auditory passages terminate there. The little bones of the ear are sometimes perfectly similar to those of animals; the labyrinth remains partly membranous, or it is formed of a single cavity. In an individual who was deaf from birth, we have found the auditory nerve wasted and reduced to a simple filament, an osseous concretion existing in the labyrinth. The ancients considered injuries of the pinna to be extremely serious, deceived by the false idea that its cartilage was very sensible; some have spoken of its fractures; its elasticity shows that simple wounds by cutting instruments have been considered as such; the small encysted tumors, which are here very common, are most generally follicles morbidly developed; the inflammation of the external ear is painful in a direct ratio with the adhesion of the skin with the subjacent parts; hence, when the skin of the auditory passage is inflamed, severe pain exists. The removal of the external ear in a wound of the head affects the hearing, but does not prevent it entirely; but we must not conclude because some are accustomed to hear without it, that the external ear is useless. The lobe of the ear is sometimes perforated, for the insertion of ear-rings; this operation is neither painful nor dangerous, as the nerves and the vessels which go to this part are few and small.

The curve of the auditory passage explains the necessity of drawing the external ear upward when we wish to examine it; in this manner we remove this curve, which does not exist in the osseous portion. When instruments are introduced into the auditory passage, to extract foreign bodies, if the instrument has only one blade, it should be carried upon the lower part, as we can introduce it in this direction more deeply, before arriving at its internal limits, as this part is longer: if they have two blades, one should be introduced below and the other above; as the vertical diameter of the passage is more extensive than the transverse, the foreign body being less pressed

upon in the latter direction, leaves a greater space for the instruments, which must pass inward and embrace it. Farther, these foreign bodies cause inflammation, suppuration of the passage, and sometimes the destruction of the tympano-auricular septum, inflammation of the tympanum, and by the continuity of the vessels, that of the cerebral membranes, of which Sabatier relates a remarkable case. The pus which often comes from the auditory passage, may be furnished by its proper membrane, may come from the tympanum, or from the mastoid region; the membranous structure of the auditory passage at its posterior part, explains this termination of the mastoid abscesses; abscesses of the parotid region sometimes point in this place, destroying the fibrous tissue of the grooves of Santorini. The very fine, and almost mucous skin of the auditory passage, often gives origin to real polypi; sometimes, however, the polypi which occur in this place, come from the cavity of the tympanum.

The tympano-auricular septum is sometimes broken by a loud noise, as is very common in cannoniers; Ribes has ascertained that this perforation may also be produced by the pressure of the hardened wax, and also by that of the handle of the malleus. Farther, it is made artificially, to allow the introduction of air into the cavity of the tympanum, when it cannot enter in any other manner, as when the Eustachian tube is obliterated. In this operation, substituted by Sir Astley Cooper for the perforation of the mastoid process, which latter seems to us more rational, as we shall show hereafter, the lower part of the tympanum should be perforated, in order to avoid the handle of the malleus and the nerve termed the cord of the tympanum, which are placed at the upper part. As the septum of the tympanum is oblique, when we wish to perforate it, we must employ a trocar, the canula of which has a fluted extremity. In violent blows on the head, the blood which flows into the cavity of the tympanum, and oozes through the Eustachian tubes or the auditory passage, after breaking the tympanum, comes, according to Beclard, from the rupture of the emissary vessels, which pass from the dura mater into the cavity, through the upper openings. The continuity of the mucous membrane of the throat with the middle ear, explains the obliteration of the Eustachian tube and lesions of the ear, in chronic affections of the throat. We shall speak of introducing an instrument into the Eustachian tube hereafter. The severe pains of internal otitis are easily explained by the resistance of the parietes of the tympanum, which prevent the inflammatory swelling, and consequently cause a compression. The rumblings, and other affections of the internal ear, which are so common in diseases of the brain, are easily explained by the connection in the circulation of the brain and this region, which

has been mentioned. This important part of the ear is doubtless often affected; but our knowledge upon this point is so slight, that anatomy does not, as yet, give any positive explanation of most of the species of deafness which are there situated.

3. MASTOID REGION.

The posterior portion of the lateral wall of the skull, the mastoid region, has very distinct limits; the mastoido-auricular fissure forward; the curved line marked by the termination of the hair, backward and upward; and the point of the mastoid process downward; it is very thick, and is not very extensive, but is nevertheless very simple and important. The mastoid region, like all those which contribute to form the parietes of the cranium, or any other cavity, presents two regions. One is covered with skin, and is convex and rough, the other, which is serous, smooth and moist, is continuous with the side of the tentorium, extending above and below it.

Structure.—1. *Elements.* This region owes its firmness to an osseous base, formed by the mastoid portion of the temporal bone, the posterior and inferior angle of the parietal bone, and by a small portion of the occipital bone, which are united by the mastoid and squamous sutures. The mastoid foramen, the portion of the lateral groove which there exists, and also the mastoid cellules, which are situated internally, communicate with the tympanum and are lined with its membrane. The external and internal periostea are remarkable; the external is dense and adheres firmly by the numerous muscles which are attached to it; the internal, the *dura mater*, contains the lateral sinus, which arises at the base of the fold. The small retrahens auriculæ muscle, of which more than one sometimes exists, and the auricular ligament belong to this region with some fibres of the occipitalis, of the sternomastoideus, of the splenius, and of the trachelo-mastoideus muscles, which there terminate. The skin and the parietal fold of the arachnoid membrane present nothing remarkable; but little of cellular tissue exists there; it is very dense, particularly on the inside of the bone.

The mastoid arteries all come from the posterior auricular and the occipital artery, the trunks of which are placed on the boundaries of the region; the last sends a meningeal branch through the mastoid foramen. All the veins follow the course of the arteries, except the great emissary mastoid vein, which goes to the lateral sinus; the lymphatic ganglions occupy the mastoido-auricular fissure; they receive the lymphatic vessels of the region, and also several from the

hairy scalp, as we have already seen; other vessels of the same order follow the course of the occipital artery.

The nerves come from the superficial cervical plexus, and are given off particularly by its mastoid and auricular filaments; the facial also gives off some which anastomose with them. The nerves, like the vessels, are some of them anterior, they are the *auricular filaments of the cervical and facial plexuses;* the others are posterior; they come from the mastoid twig of the cervical plexus.

2. *Relations.* The skin forms the first layer; it is intimately united to the deep parts, by a sub-cutaneous cellular tissue, which is but slightly adipose; more deeply, we find the retrahentes auriculæ and the occipitalis muscles, the attachments of the sterno-mastoideus, those of the splenius below it, and finally, those of the trachelo-mastoideus muscle under these latter.

On the inside of the retrahens auriculæ muscle, appear the anterior vessels and nerves in the mastoido-auricular groove; at the posterior part of the region, the vessels and nerves are sub-cutaneous. The external periosteum and the bones come next, and if we divide them, we penetrate: first, down into the mastoid cells, and after passing through them and their internal wall, we come to the dura mater and the parietal fold of the arachnoid membrane; second, in the centre of the region, we fall on the tentorium of the cerebellum, and the lateral sinus.

Development. The mastoid region in the adult is very firm, but this is not true in the fetus; the bones which form it are separated by a membranous space, which continues some months after birth; it is the *posterior and lateral fontanelle.* The absence of the mastoid process in early life, renders this region much less extensive, proportionally, than in the adult; at first, the mastoid cells do not exist; in aged people, on the contrary, they fill the whole skeleton of this region, and are not confined even to the temporal bone.

Varieties. Bernard, a distinguished physician of Toulouse, has shown us a child which presented on each side in this region an accidental auditory passage, communicating with the regular channel; we have seen no instance of this mentioned in any author.

Pathological deductions and operations. Hernia of the encephalon, whether of the cerebrum or cerebellum, may occur through the fontanelle in this region: but they are not most frequent in this place. Wounds, whether anteriorly or posteriorly, may be attended with hemorrhage, as the vascular trunks of this region are situated anteriorly and posteriorly; the bones are sometimes fractured, with depression toward the tympanum only, which at first view, might be easily considered a more serious injury. Caries, necrosis, or exostoses of

the mastoid process, are not unfrequent in syphilitic affections. Abscesses in this region, which are generally caused by an alteration in its osseous portion, often show themselves at a late period, by pointing, as we have already said, in the auditory passage. The tumors which exist in the mastoido-auricular groove, may be produced symptomatically in diseases of the occipito-frontal region; they are engorgements of the lymphatic ganglions. The skin of this groove is very subject to scrofulous ulcerations, in young children; the mastoid emissary vein explains the correctness of the principle generally given, to apply leeches on this region in cerebral affections. It was proposed by Jasser, a Prussian surgeon, to open in this place an artificial passage, on the mastoid cellules, for different purposes, particularly to admit the air into the cavity of the tympanum, when the Eustachian tube was obliterated. This operation is practicable only in the adult, since the mastoid cells do not exist until then; it gives the individual an accessory auditory passage in the mastoid region. This operation is certainly rational: the facility of performing it, the few parts which are interested, if we avoid the mastoido-auricular fissure where the nerves and vessels are situated, the freedom with which the air must penetrate through this passage which may be regarded as an artificial Eustachian tube, and the preservation of the membrane of the tympanum are certainly in its favor; this latter circumstance should cause it to be preferred to the perforation of the membrane of the tympanum, proposed by Cooper. The fatal accident which happened to Just, physician to the king of Denmark, who died of erysipelas, after this operation had been performed upon him by Professor Koelpin, of Copenhagen, should not cause it to be abandoned; in fact, any operation, however trivial, may cause serious symptoms; even venesection, and the most simple incision of the soft parts, have sometimes been attended with them, yet these operations are still performed.

ORDER THIRD.

INFERIOR WALL OF THE CRANIUM.

This wall of the cranium belongs to it only by one of its surfaces, the superior; the inferior, on the contrary, blends with the face and the neck, where we shall treat of it; our remarks here, then, will be very brief; it forms a region, that of the *base of the cranium.*

REGION OF THE BASE OF THE CRANIUM.

This region represents the base of the arch of the cranium; it is flattened and semi-circular, and arranged so that its anterior part rises above the central, and this above the posterior.

Structure.—1. *Elements.* Its skeleton is thick, and formed by bones which have many of the characters of the short bones; it presents numerous openings, through which pass a great many vessels and nerves; it forms, a little posteriorly, the occipital foramen; the internal periosteum adheres to it in a direct ratio with the number of its different openings, and it contains many sinuses, the circular and the transverse sinuses of the sella turcica, the transverse sinus of the basilar surface, the circular sinus of the occipital foramen of Ridley, the occipital, the cavernous, and the superior and inferior petrous sinuses. The parietal fold of the arachnoid membrane exists in every part; it enters into each opening, and forms there a small cul-de-sac, and soon reflects on the nerves and vessels to re-enter into the skull. The anterior, middle, and posterior meningeal arteries, come from the sources already mentioned, with their attendant veins; but we find in every part, numerous emissary veins, which come from the nasal fossæ, through the foramen lacerum, and many other foramina, which are very apparent on the sella turcica; the ophthalmic vein, also, by its opening with the cavernous sinus, presents the arrangement of the emissary veins; but little is known of the lymphatic vessels. There are no nerves in this region, except those which pass through this wall.

2. *Relations.* These are extremely simple, and are, considered from without inward, the bones, the dura mater, and the arachnoid membrane. All the sinuses occur in the middle and posterior planes of the region of the base of the cranium; the first are situated above or on the sides of the sella turcica; the second on the edges of the petrous process, on the basilar groove, on the sides of the internal occipital crest, and around the occipital foramen. The cavernous sinus is situated on the side of the sella turcica, and contains within it the internal carotid artery, on the outside of which the nerve of the sixth pair, and two ascending filaments of the superior cervical ganglion of the great lymphatic nerve are situated; in its external wall, on the contrary, are placed from above downward, the nerve of the third pair, that of the fourth pair, and the ophthalmic branch of the fifth pair; these last two are situated forward, on the same plane, above the first.

Development. The bones of this region are formed and united rapidly, and never present any fontanelles.

Pathological deductions and operations. A part or the whole of this region may be deficient; we possess the head of a fetus, in which the cribriform plate of the ethmoid bone is absent. When this wall of the cranium is entirely deficient the whole cranium is wanting; in this respect this wall differs from the others; its priority of develop-

ment, and its uses, as it serves to sustain the whole cavity, sufficiently explain this curious result. These functions account for fractures of this region, which are always caused by counter-blows; when effusions exist in the space between the dura mater and the bones, they are circumscribed and very flat, on account of the intimate adhesion of these parts. The severity of the fractures depends on causes disconnected with this wall; we shall speak of them soon. Pus sometimes forms in the sinuses; we have seen the two cavernous sinuses filled with it. Fungous tumors may arise from the dura mater, and proceed externally toward the neck or the face. At the hospice of Bicetre, we dissected one which had destroyed the cribriform plate of the ethmoid bone, and had proceeded into the olfactory cavities. We will speak hereafter of the use which may be made of the emissary veins, which come from the nasal fossæ and from the orbit.

PARAGRAPH SECOND.

CAVITY OF THE SKULL.

The different regions which have been described, enclose a cavity which may be termed the *cranial*, *encephalic*, *cerebral* cavity, &c. Its oval form, its variable dimensions, do not belong to our work; we refer, on this subject, to the excellent treatises on descriptive anatomy by Meckel, Boyer, Bichat, &c.

This cavity is regularly separated into two secondary cavities, by a horizontal fold of the internal periosteum of the cranium, the tentorium. One is termed the *cerebral*, the other the *cerebellar*. The first is upper and anterior, is larger, and is imperfectly partitioned by the falx of the dura mater: the occipito-frontal, the temporal, the auricular, and a part of the mastoid region belong to it, with the two anterior planes of that of the base of the skull. The second, situated lower and posteriorly, is smaller, and is regularly divided by the falx of the cerebellum; the posterior plane of the region of the base of the skull, belongs to it exclusively, with the lower part of the mastoid region. The communication between these two sections of the cavity of the cranium is oval, and rests on the basilar groove. It is formed in great part by the tentorium of the cerebellum.*

The cerebrum occupies the whole anterior cavity with which it is connected above, by some veins, below by some nerves and large arte-

* It is only in animals, where the posterior part of the cerebrum is but slightly developed that we can say, that the tubercular quadrigemina are protected in this point by the portion of the occipito-frontal region, the skeleton of which is formed by the upper part of the occipital region, the *superior occipital bones*.

ries. The cerebellum is situated in the posterior cavity, and is united with it only by some veins. Over the communication, we find the mesocephalon, which is continuous with the spinal marrow: this latter is connected anteriorly with the edge of the opening by some nerves and arteries : it is attached there posteriorly by the veins of Galen. These nervous centres are lined by the visceral fold of the arachnoid membrane, which is continuous with the parietal fold, on the vessels and nerves which pass from the cerebrum to the parietes of the cranium, or reciprocally, and which touches only the top of the circumvolutions, closing the grooves between them: the *pia mater* lies under it; it follows all the sinuosities of the surface of the encephalon, differing in this respect from the arachnoid membrane. A more ample description of the reciprocal arrangement of these two membranes, and of the different portions of the encephalon is curious, and belongs to descriptive anatomy: for it, we refer to the works already mentioned, and particularly to Meckel: we will only remark, that the arteries of the brain send some branches to the outside of the skull, into the cavities of the internal ear, of the eye, and even of the forehead, between the nervous centres and these regions: we should remember that the prominences which give rise to the nerves, and which consequently maintain life, rest on the region of the base of the skull, which in most points is amply protected from external injuries.

Development. According to all appearances, the cavity is at first open, but it soon closes.

Varieties. Its varieties of capacity are very numerous, and depend on those in the size of the encephalon ; Ribes has proved that in old persons this cavity diminishes by the collapse of its parietes.

Pathological deductions and operations. Hernias of the internal organs of the skull may exist: these have been mentioned already. The cavity may be contracted by the depression of a part of its osseous envelope, in fractures: in these cases trepanning is indicated. Effusions of different natures occur on the loose surface of the serous membrane, and are necessarily diffused, as when they are situated in the pia mater, on the surface of the cerebrum: but this is not true of those within the brain: when the fluid is contained at first in a ventricle, it soon extends into the others, on account of the easy communication which naturally exists between them, especially between the middle and the two lateral ventricles. If, however, we connect our opinions on effusions within the cavity of the skull with those suggested when speaking of its parietes, and determine generally in what cases of effusion trepanning is required, we shall see that this operation can be useful only when the effusion on the inside of the

bones being circumscribed; first, it is indicated only in those situated between the bones and the dura mater, between this and the parietal arachnoid membrane, or in the substance of the brain; second, that it should be avoided, as improper, in those of the cavities of the arachnoid membrane or of the ventricles, or when they are situated in the loose tissue of the *pia mater*. It is difficult to estimate the different situations of these effusions, it is only important to determine whether the effusion be circumscribed or not, in other words, whether the operation of trepanning be indicated or not. An effusion is circumscribed, when it causes a local compression which is attended with a well defined paralysis on one side of the body: it is diffused, if it be followed by a semi-paralysis which affects both sides of the body. We cannot be certain whether an effusion is situated anteriorly or posteriorly; in regard to the side, it is generally opposite to that paralyzed;* these latter circumstances are so vague, that they prevent us from trepanning in cases of effusion not traumatic. The greater size of the cerebrum, and particularly its direct relation with the occipito-frontal region, which, is the most exposed to external injuries, explain the frequency of its traumatic injuries, while those of the cerebellum are extremely rare: on the other hand, we can easily conceive of the severity of injuries of the base of the skull, especially of effusions in that part caused by fractures, when we remember that the nervous enlargements which directly sustain life by giving off the respiratory nerves, rest on this wall. It is even curious to compare these lesions, which are frequently very small and fatal, with those of the arch of the cranium, and of the cerebrum, which are more extensive and often simple: in fact, the upper part of the encephalon belongs but very slightly by its functions to the organic life, it is devoted entirely to that of relation. The arterial connection of the brain with the ear, the eye, and the forehead, explains the burning of the ear, the redness of the eye, the pains in the forehead; symptoms which are so common in even the slightest cerebral affections.

* This, however, is not always the case: we have the records of two cases of apoplectic individuals, in whom it was proved by post mortem examination, that the effusion might be situated on the side of the paralysis; in these two cases, the posterior extremity of the hemispheres was affected. If we add that Gall has demonstrated that the fibres of the olivary eminences communicate with this part of the cerebrum, that they do not intercross in the superior bulb of the medulla like those of the pyramids, and that the latter expand in the skull and form nearly all the hemispheres, we shall account for the paralysis on the side of the effusion, in rare cases where the posterior part of the hemispheres is alone affected, and of the paralysis on the opposite side, which commonly supervenes, because the effusions most frequently take place in the course of the expanded fibres of the pyramid.

ARTICLE II.

OF THE FACE.

The face is the portion of the head destined particularly for the organs of the senses; it is blended above with the cranium, below and backward with the neck; it is unattached forward and on the sides. Its variations in the races of the human species, and in animals, are very numerous; we must mention them merely in a general manner, at the same time that we point out the laws to which they are submitted; we shall first attend, however, to the face in the adult.

It is very difficult to define the shape of the face; the form of a quadrangular pyramid with its summit truncated posteriorly, which is mentioned by authors, gives only an imperfect idea of it. The face occupies the anterior part of the head, and its direction is a little oblique to the horizon, with which it forms an angle from seventy to ninety degrees; this facial angle, the importance of which has been demonstrated by Camper, must be included between the frontal protuberance and the anterior part of the jaws.

The size of the face in the adult, is only a fourth of that of the head; it is one third of that of the skull. The best mode of making this calculation is to consider a head in profile, or rather, as M. Cuvier advises, to make a perpendicular section of it. This examination also demonstrates, that as the anterior part of the face is almost the only unattached part, the variations in development are manifested only in it; hence it follows, that the facial line of Camper, if it belonged only to the anterior plane of this great region, would indicate with exactness its absolute size by its angle with the horizon; but its extremities are common to the skull and the face; its direction, consequently, being influenced by these two parts, can afford conclusions only in regard to their proportional development.

Structure. The face, being situated at the upper extremity of the air passages and digestive tube, forms cavities which protect the three principal organs of the senses, and shares some of its elements with the cranium and the neck. Its skeleton is represented by the jaws; the muscles are attached to the bones mostly by one extremity only. Numerous arteries are given off to it, especially by the internal and external maxillary arteries; these arteries are attended with veins. These different vessels frequently anastomose with each other, and with those of the cranium. Two nerves are distributed principally to the face; the facial nerve for the respiratory motions and for the

expression, and the trifacial nerve for the general sensibility, and for the motions required by digestion. The cellular tissue is dense on the median line; it is more abundant and looser on the sides. The skin is remarkable for its thickness, its vascularity, its numerous follicles, and its hairs; it is continuous with the mucous system at the openings of the eyelids, of the nose, and of the mouth.

Development. The face is formed very early in the fetus; at first view, it would seem to be an exception to the general law of development of the trunk by two lateral halves;* but this is not the case. Its existence is connected with that of the organs of the senses, and with the nerves which belong to them.

During infancy, the absolute size of the face is very small; this is true also of its size compared with that of the cranium, which may be inferred from the great development of the latter, and from our remarks upon the inverse ratio between these two parts of the head. The *facial line* is then vertical, the angle it forms with the horizon is a right angle, and gives a peculiar character to the whole head.

At a later period, when the deciduous teeth are formed, the face increases very much, the skull remaining almost stationary; the face begins to project, the facial line is inclined, and its angle becomes more and more acute. This arrangement exists in the greatest degree at the age of twenty five or thirty, when the wisdom teeth are formed, and give the face a greater development, throwing the jaws forward. In the old man, the face is inclined still more, and the facial angle becomes also more acute; this, however, does not depend upon its real enlargement, but rather on the collapse of the cranium, and the torsion of the face forward, which torsion is caused by the maxillary bones, which at the same time become lower. The effect of this shortening of the face, which is communicated to it by its skeleton, is a relaxation of the soft parts, which loose their elasticity, fold, and form more or less distinct wrinkles.

Varieties. In the female, the face is narrower across than in the male; it is also smaller. Generally speaking, the facial angle in the Caucasian race, is eighty degrees, while it is not more than seventy-five or seventy in the Mongolian or in the African race.† A much

* The separate facts related by authors on the development of the mouth and the nostrils, would seem to show in fact that the face is formed by three pieces, a median and two lateral parts.

† Authors are wrong in stating with Ovid that one of the characters of human nature consists in the direction of the face and eyes towards the heavens.

> "Os homini sublime dedit, cœlumque tueri
> Jussit, et erectos ad sidera tollere vultus.'

In fact this arrangement becomes more and more marked as we descend in the scale of animals, and the fish termed *uranoscopia* presents it in a greater degree than man.

greater and very remarkable gradation is observed in animals. These measurements are highly important, as they indicate the proportional development of the face, and of the cranium, and lead to an estimate of the size of the brain, and to a certain extent, of the degree of intelligence. The ancients understood this truth so well, that in order to give more majesty to the figures of their gods and heroes, they elevated the facial line so that it was almost vertical; the owl, with them, is an emblem of wisdom, but storks, on the contrary, are emblems of weakness and foolishness. In every case, in animals and also in man, although this objection has less weight with him, we must regard the development of the forehead by the formation of the frontal sinuses; without this precaution, we should be constantly led into error, admitting in some individuals a capacity of the cranium, and consequently a degree of intelligence, which they do not possess.* We can then imagine that in the child, in whom these sinuses do not exist, the facial line may furnish more exact results than in the old man. Such are the great varieties of the face in the principal human races, varieties which may be measured also by comparison with the cranium, although this can be obtained directly by calculating its area, and comparing the results obtained in different individuals; but this estimate cannot be made, except upon heads dried and prepared expressly.†

Uses. Besides the uses of protecting the organs of the senses, the face performs various motions, which modify it very much, and take place in its lower part;‡ while the upper, which is motionless, serves as a point of support, and communicates to the cranium, with which it is united, the motions transmitted to it.

Pathological deductions and operations. The face may be entirely deficient, *aprosopia;* Lecat, Curtius, and Beclard have related instances of it. This deviation of formation, however, in which the ears are inclined downward, and are very near each other, is seldom so extreme, that some imperfect rudiments of the face do not exist on the sides. The median parts are often deficient, the lateral being

* We must also remember, that the capacity of the skull does not always give the degree of intelligence, because some of the parts which are situated in this cavity, which have no connection with the intellectual functions, may by their development, require a very large brain-case.

† Other modes besides the facial line have been proposed, to arrive at the variations of the face in the different races of men and animals, but all, except that of Cuvier which has been stated, give only the proportional development of the skull and face.

‡ In man, the upper part of the face does not move upon the lower, as it does in venomous serpents: but this abnormal motion is observed in him, when the motions of the lower jaw are prevented: the upper part of the face, then, simply follows the skull, which is thrown back on the vertebral column.

blended together; finally, sometimes we observe more or less central fissures, evidently from the arrest of development.

The face is composed of three very distinct groups; the nostrils, the mouth, and the orbits; it also includes the zygomatic fossa, which is a small region, enclosed between the cranium and the face.

PARAGRAPH FIRST.

NOSTRILS.

The nostrils are anfractuous cavities, which are designed to receive the impressions of smell. They are situated at the upper part of the air passage, of which they may be considered as a modification. Their limits are very exact; they are placed between the base of the cranium and the mouth, having on the outside the region of the cheeks, the orbits, and the summit of the zygomatic fossa, which they bound in their turn; they open externally, forward; and into the pharynx, backward.

The nostrils are nearly similar; they are formed of a portion which projects in the face, the *nose*, and of another deep seated portion, the *nasal fossæ;* hence two regions, the *external olfactory*, and the *internal olfactory*, which are very analogous in respect to their internal surface, structure, development, uses, &c.; it is convenient, then, first to give a general description of the nostrils, which are formed by these regions; we shall then examine them separately; in this way we shall avoid numerous repetitions.

The surface of the nostrils is very extensive, which is owing to the more or less curved prominences* of bone, on which their internal membrane is expanded, and also to the prolongations or sinuses which they send into the supraciliary region, the region of the base of the skull, and the malar region; prolongations which we shall not mention here. The first arrangement, while it increases the extent of the surface of the nostrils, singularly contracts their cavity in the corresponding points; this is the largest downward and forward.

Structure. The parietes of the nostrils are formed by a skeleton which varies in solidity; on the inside of this, we find in every part a fibro-mucous membrane, called the pituitary, which is continuous anteriorly with the skin, and posteriorly with the mucous membrane of the throat and tympanum, particularly with the latter, through the Eustachian tube. This general layer receives arteries from different sources; some come anteriorly from the facial artery;

* These prominences or turbinated bones are twisted in a direct ratio with the development of the olfactory faculty. Of all animals, the dog is the most remarkable in this respect.

others come to it from the orbit, the ethmoid arteries; the last from the zygomatic region, the spheno-palatine, the pterygo-palatine, and some twigs of the posterior palatine artery. The veins generally follow the course of the arteries, except the small emissary vein of the fronto-ethmoidal foramen, which goes to the origin of the superior longitudinal sinus, and also some others which pass through the sphenoid bone, to open into the cavernous, transverse, and coronary sinuses. Thus the cerebrum and its membranes are connected with the nostrils by the veins and arteries, particularly the ethmoidal. The lymphatic vessels are not known, except anteriorly. The nerves which are common to the two parts of the region of which we are speaking, come only from two sources, the olfactory, and the fifth pair; this latter sends to it divisions of its filaments, the spheno-palatine,* the posterior palatine, the internal frontal, and the infra-orbitar nerve.

Development. The nostrils are developed by several pieces which unite on the median line; two lateral pieces, formed of secondary points, represent the orbito-nasal septa; two others in the centre,† the median septum. These parts are at first very distinct, but afterwards unite; the lateral appears sooner than the last. This regular development is subordinate to that of the olfactory nerve; if this be deficient, the nostrils, also, are generally absent; sometimes they are formed but irregularly; we possess a remarkable instance of this in a fetus, where the median septum and also the cribriform plate of the ethmoid bone, which make a part of it, are entirely deficient; the cerebrum of this individual has only one median lobe.

Varieties. In the infant and the old man, the cavities of the nostrils are narrow, for opposite reasons; the slight transverse development of the whole of this region in the former, a considerable prominence of the turbinated bones in the latter.

Sometimes the septum is perforated, although this may result neither from an operation nor from disease; sometimes it is displaced toward one side.

Pathological deductions and operations. By a slow suspension of development, such as we have described, we find the nostrils blended together, their septum being absent. If, on the contrary, the development is arrested sooner, the nostrils are entirely deficient, *anarinia,*

* The ganglion of Meckel, which sends off this nerve and the posterior palatine nerves, may be considered simply as an enlargement of the superior maxillary nerve of the fifth pair.

† The formation of the nasal septum by two points, is far from being admitted by authors: we have ascertained it to be the case in several fetuses, particularly in the vomer, which bone, in the adult, is also formed of two layers, which arise singly in the fetus. Thus the development of the nostrils is not an exception to the general development of the trunk, as it would seem at first view.

and the orbits are blended, or separated only by a thin septum. When speaking of the arch of the palate, we shall mention the division of the lower wall of the nostrils. The communication between the vessels, which we have stated as existing between the brain and the face, accounts for those epistaxes and those corizas which supervene in affections of the cerebrum, and sometimes serve as crises. The advice given by some practitioners, to apply leeches on the pituitary membrane in the same cases, is also founded on the same anatomical arrangement.

1. EXTERNAL OLFACTORY REGION.

NOSE.

The nose is that portion of the olfactory apparatus which projects in the face. Its form is pyramidical; it is separated above from the forehead and the eyebrows by a very marked depression; below, it is united at a right angle with the upper lip, from which, also, it is easily distinguished; on the outside, it is separated from the eyebrows and cheeks by the naso-palpebral and naso-malar grooves. The nose is situated on the median line; it is symmetrical, but always tends a little to the right side at its point; this depends, according to Beclard, on the habit of wiping the nose with the right hand.

This region presents two surfaces; the internal is hairy and mucous, and forms the parietes of the nasal cavity: the external is smooth and covered with skin, and presents, especially at its lower part, numerous and very evident follicular openings, through which the slightest pressure causes a sebaceous substance to ooze in the form of little worms. This surface presents; the back of the nose, which varies in its direction: the alæ formed by planes the direction of which is forward and outward; the root, and finally the base, on which we observe the lobe and the anterior openings of the nostrils, the inside of which descends lower than the outside: this arrangement shows in a profile view of the head, the corresponding opening of the nose.

Structure.—1. *Elements.* The nose is formed of a skeleton, which is osseous at the upper part, where it is formed by the nasal bones and the ascending processes of the superior maxillary bones: cartilagino-membranous at the lower part, where we find the cartilage of the alæ and septum, their fibrous membrane and the membranous cartilages of the openings. We would also remark, that the septum is osseous above and below, and is formed by the perpendicular plate of the ethmoid bone in the first point, and the vomer in the second. The

muscles of this region are the pyramidal and the triangular muscles, some fibres of the levator labii superioris alæque nasi, and of the depressor alæ nasi. The cellular tissue is very compact at the lower part, but looser above; but little fat exists there; more of it, however, is found below. The existence of the skin and of the pituitary membrane has already been mentioned. The arteries of the nose are numerous, and are given off by the *facial* artery, or by its *superior labial* branch, by the *ophthalmic* and *infra-orbitar* arteries; a small branch passes from the inside to the outside, through a foramen in one of the nasal bones. The veins of the nostrils follow the course of the arteries with the exception mentioned in the general description. The nerves of the nose come principally from two sources, which it is curious to mention, since the fine experiments of Charles Bell; some are filaments of the facial nerve, others come from the fifth pair, and particularly from the infra-orbitar and nasal branches of the ophthalmic nerve of Willis; this latter is distributed to the nose by its external and also its internal twig, so remarkable for its course, and forms the nasal-lobar filament: the upper part of the nose receives some twigs of the olfactory nerve.

2. *Relations.* In proceeding from without inward, the following parts present themselves in a very regular order; the skin is attached firmly below by a cellulo-fatty layer, which is remarkably dense in this point: this layer is distributed generally, and in it are found most of the vessels and nerves: next comes another layer, formed by the pyramidal, the triangular, and the common levator muscles; below the triangularis muscle appear; the naso-lobar nerve, and the osseo-cartilaginous and membranous skeleton; next the pituitary membrane, and then we come into the olfactory cavity.

Varieties. The nose presents numerous varieties, which generally depend on the variable position of its back; this is convex in the aquiline nose, concave in the turned up nose, and flat in the broad flat nose. Beclard remarks, that in left handed people the nose is inclined to the left.

Pathological deductions and operations. The nose participates in all the general defects of the nostrils; sometimes it alone is deficient; this, however, occurs less frequently than the internal olfactory region. In fact, in cyclopia, where the nose does not exist, we generally find it contracted in the form of a tube, and situated most commonly above, rarely below the single orbit; sometimes the openings of the nose are obliterated. Some instances of a double nose are cited. Fractures of the nose are sometimes serious, which are explained very readily by the concussion extending from the proper bones of the nose to the perpendicular plate of the ethmoid bone, and

from this to the horizontal plate; hence results a fracture of the base of the cranium, which is extremely dangerous. On account of the great vascularity of the nose, it is laid down as a precept, to unite its wounds, even when a part has been removed; nevertheless, in this case, there is little hope of success, although it is not impossible. The same reasons have suggested the idea of making a new nose, when the nose is deficient. This operation seems to have been invented in those countries where criminals are punished by cutting off the nose: it has been used from time immemorial by the Indians, and their method is certainly much more rational than that of Taliacozzi, who has given a good description of it; but it was known before him. The Indians used the firm skin of the frontal region, but Taliacozzi advises to form a new nose from the skin of the fore arm. In both cases the mutilated edges of nose should be pared off, and we should fit upon them the base of the triangular fold which has been cut, and which is still attached by its point to the place from whence it was taken. The nose is frequently the seat of tumors of various sizes; these are generally cutaneous follicles morbidly developed; the follicular nature of the skin easily accounts for it. The distribution of the naso-lobar nerve to the alæ of the nose, and also its origin from the nasal nerve of the external branch of which belongs to the eyelids, has caused the advice sometimes neglected, of applying blisters on the alæ of the nose in ophthalmia.

INTERNAL OLFACTORY REGION OR NASAL FOSSÆ.

The internal olfactory region is composed of the anfractuous part of the apparatus; which, however, must not include the sinuses which are connected with other regions.

It is situated deeply in the face, and is continuous with the nose. The turbinated bones belong to it particularly, and increase the surface of the olfactory membrane very much, contracting the transverse extent of this cavity; above, it does not measure more than three or four lines.

The internal olfactory cavity is bounded by parietes which present two faces; the external belongs to the cranium above, to the arch of the palate below, and on the outside to the zygomatic region of the orbit and cheeks: the internal is loose and mucous; it is plane inferiorly and internally; superiorly, it is at first horizontal, it afterwards inclines backward, and in this point presents the opening of the sphenoidal sinus, which is extended into the base of the cranium; on the outside, it is irregular, and presents three prominences, which are convex inward and concave outward; these are the turbinated bones,

which circumscribe the three meatuses; the surfaces of both diminish from below upward, and at the expense of their anterior part, the posterior continuing unchanged: the inferior turbinated bone descends to within two lines of the floor of the cavity. The inferior meatus, which is the largest and extends the farthest forward, presents the only opening of the nasal canal, an opening which is provided with a valvular mucous fold which floats inferiorly, and is concealed by a prominence, the importance of which was first demonstrated by Beclard; this prominence is formed particularly by the root of the ascending process of the superior maxillary bone. The middle meatus presents the contracted opening of the maxillary sinus and that which is common to the frontal sinuses, and to the anterior ethmoidal cellules; this latter is continuous by a very apparent groove, an arrangement generally but little known. The internal and osseous portion of the lachrymal sac is situated before this meatus, and not on a level with it. The superior meatus presents anteriorly, the opening or openings of the posterior ethmoidal cellules, while the sphenopalatine foramen, and the zygomatic region look to its posterior part. These different parietes are continuous forward, directly with those of the nose, and backward, with that of the pharynx or a quadrilateral opening, the outside of which, at its centre, looks to the extremity of the eustachian tube, while the lower is extended by the velum palati.

Structure.—1. *Elements.* The skeleton of the olfactory region is entirely bony; the cribriform plate of the ethmoid and the sphenoid bone; the horizontal part of the maxillary and palatine bones below; the vomer and the perpendicular plate of the ethmoid bone on the inside; the ethmoid bone also by its lateral masses which are grooved with cells, the unguiform bone, the vertical portion of the palatine bone, of the superior maxillary bone, and the inferior turbinated bone, on the outside; all these bones, as we have already remarked, belong to this region only by one of their faces. This skeleton is remarkable for its thinness and resistance above on the inside, and on the outside. Farther, we find here the pituitary membrane, which has been fully described, when speaking of the nostrils; the emissary veins, and the ramifications of the olfactory nerve belong to that portion of it which is expanded in this part.

2. *Relations.* The relations need scarcely be mentioned; the mucous membrane and the bones exist above in most parts; on the septum, one of the spheno-palatine nerves, termed the naso-palatine nerve, descends anteriorly toward the anterior palatine foramen.

Development. This presents nothing remarkable.

Varieties. Sometimes more than three turbinated bones exist; and we have found five, and generally four.

Pathological deductions and operations. The internal olfactory region is entirely deficient, more frequently than the external. Its skeleton may be fractured simply by blows upon the nose, or by a wounding instrument which passes through the mouth, the orbit, &c. We can form some idea of the severity of these fractures, if situated at the upper part. In coriza, the tumefaction of the mucous membrane contracts the cavity which is already rendered narrow by the turbinated bones; hence a difficulty of breathing through the nose; the swelling of the valvular fold of the nasal canal under the same circumstances causes a flow of tears. Foreign bodies if introduced, and placed upon the floor, glide along easily and fall into the throat; if they are pushed upward, they become fixed; these differences are explained by the differences in the capacity of the cavity in these places. Polypi arise most frequently in this portion of the nostrils, especially on its outer wall; their first effect is to flatten the turbinated bones on the outside, and to enlarge the cavity; the hardest, which are fibrous, dilate the parietes still farther, and often enlarge one of the regions at the expense of the other. We have observed at the hospice Bicetre, a case which is, as far as we know, unique; a fibrous and vascular polypus had dilated the spheno-palatine foramen, and it afterwards extended through this opening into the zygomatic fossa. The prominence of the ascending process of the maxillary bone serves as a guide for inserting the catheter into the nasal canal; in order to do this, we introduce on the floor of the nostrils a sound which is properly curved, its point looking outward; when it has penetrated an inch, it is gently withdrawn, rubbing the point against the outer wall; then at the moment it is arrested by the prominence mentioned, the sound is depressed, and thus carried a little inward, and by this vibratory motion, the instrument easily penetrates into the nasal canal. The relation likewise of the opening with the eustachian tube, and the posterior opening of the olfactory canal, serves as a guide for introducing an instrument into the tube; for this we must employ a sound which is curved at an angle of one hundred and thirty-five degrees; it must be introduced horizontally, its point being directed downward, and rubbing against the floor of the nostrils; and when it has come to the posterior edge of this floor, which can be determined by its slipping into the pharynx, it should be rotated outward a quarter of a circle, and at the same time it is made to vibrate in this direction; it then easily penetrates into the tube, which is perceived by its being fixed.

PARAGRAPH SECOND.

OF THE MOUTH.

The mouth is the facial portion of the digestive tube; it is an oval cavity, formed by several distinct regions; its dimensions may be estimated by measuring the antero-posterior, the transverse, and the vertical diameters, which vary every instant; these varieties, however, take place anteriorly; its capacity is more uniform posteriorly.

The mouth is unmated and symmetrical, situated on the median line of the body, below the olfactory region, and above the neck; it is bounded on the sides by the malar regions; it opens anteriorly, and into the pharynx posteriorly; its lateral and anterior parts are the only portions of the external surface which are loose and cutaneous; its inner surface is mucous.

In this portion of the face, we must study the buccal cavity and its varieties; we have already spoken of the former, which belongs to descriptive anatomy, while the latter make a part of the anatomy of the regions.

Structure. The buccal parietes have several things in their structure which are common; a skeleton formed by the inferior and superior maxillary bones, and the horizontal portion of the palatine bones: a mucous membrane, abundantly provided with follicles, and covering the buccal glands; this membrane is raised in certain points by the ducts of the salivary glands, which perforate it obliquely, after passing a certain distance below it.* It is doubled outward by parts which vary in almost every point, and should be examined when treating particularly of the buccal regions; always excepting those of the lower wall of the mouth, which are imbedded, as it were, in the neck, and will be described hereafter.

All the buccal arteries come from two sources, the facial and internal maxillary arteries; the veins have the same destination, and the lymphatic vessels go to the sub-maxillary ganglions. The nerves come particularly from the facial and from the fifth pair of nerves; the nerves of some organs come exclusively from the latter, but most frequently from both.

Development. The mouth is at first separated on the median line into two distinct parts, which exist for a long time on its skeleton, and is completed by their uniting in the middle, which union is particularly rapid in the soft parts. The upper lip and the palatine arch

* In regard to their anatomical arrangement and uses, the course of the salivary ducts through the buccal parietes, may be compared to that of the ureters in the parietes of the bladder.

anteriorly, do not form an exception to this general law of formation, as we shall prove hereafter.

Varieties. The varieties of the mouth are very numerous; they affect the dimensions of its anterior opening and its prominence; in some races, this prominence is very remarkable, particularly in the negro.

Pathological deductions and operations. The defects in the development are here very important, and are deduced naturally from our remarks. The mouth is sometimes deficient, *astomia;* in this case, we often find on the sides some rudiments of two lateral portions which would have formed it. Sometimes the development is arrested at a later period, the whole mouth exists, but it is formed of two pieces, which are distinct superiorly.

The parietes of the mouth are composed of the following regions; the palatine, the palatal, the labial, the mental, the malar, the amygdaloid, and the glosso-infra-hyoid region, which belongs to the neck, where it will be described.

1. PALATINE REGION.

This unmated and symmetrical region forms the arch of the mouth, and is united with the floor of the nostrils; it thus separates the two median cavities of the face; it is continuous anteriorly with the upper lip, posteriorly with the velum palati, and laterally with the malar region. These latter and the lip are separated from it by a groove where the buccal mucous membrane is reflected.

The unattached surface of this region is mucous: it is concave in every direction, particularly in the transverse; we there find a very apparent median raphe, and anteriorly some transverse folds; its lateral and anterior parts are formed by the upper alveolar edge, and contain in the adult sixteen teeth.

Structure.—1. *Elements.* The palatine region presents a great resistance, which depends on a skeleton situated very superficially, resting on the pterygoid process of the sphenoid bone, and formed by the horizontal portions of the superior maxillary and palatine bones. It presents a median and a transverse suture, the anterior, and the two posterior palatine foramina; finally, the teeth should also be counted; the first great molar tooth corresponds by the top of its root, and of its socket to the lowest part of the maxillary sinus. The other elements of this region are, the mucous membrane covered with a thick epidermis; a very dense fibro-cellular tissue; some arteries given off by the posterior palatine, the alveolar, the infra-orbitar branch of the internal maxillary, and the superior coronary branch of the facial artery; some veins which follow the same course; a few lymphatic vessels, and

some nerves which come from the fifth pair only,* by the palatine and alveolar twigs.

2. *Relations.* The relations hardly deserve to be mentioned; we find successively, the mucous membrane, adhering intimately to the neck of each tooth, attached to the skeleton by a very remarkable fibro-cellular tissue, in the centre of which the principal palatine vessels and nerves ramify in the course of a line drawn from the posterior to the anterior palatine foramen; the middle palatine nerves and vessels, which rest on the inner part of the alveolar edge, and on the outside of it, the alveolar vessels and nerves posteriorly, the infra-orbitar anteriorly, and finally, beyond this, the skeleton.

Development. The median raphe explains the central union of the two sides which compose this region in the fetus; it is developed anteriorly, as the upper lip; posteriorly as the velum palati; hence we shall mention the development of these three regions collectively.

Varieties. In the very young embryo, the alveolar edges do not exist at first; this region is level with the cheeks; as the teeth are developed, the lateral parts become prominent; at first the transverse diameter predominates, the antero-posterior follows the formation of the teeth; the latter by their development have a remarkable influence on the direction of the pterygoid process: they gradually straighten it, and although oblique in the young child, it becomes perpendicular in the adult; it again becomes oblique in the old man, when from the loss of the teeth, the alveolar processes are restored to their primitive state.

Pathological deductions and operations. As the development of this region has been referred to another place, we shall also defer the examination of its deviations of formation, which depend on the arrest of its development. In wounds, a hemorrhage may ensue from the vessels of the palatine arch, which it is difficult to arrest by a ligature, on account of the density of the tissue in which the vessels are situated; a density which renders it impossible to grasp them with forceps: we must then cauterize them, which we have seen done by Dupuytren, after amputating this region; this skilful operator has removed nearly the whole palatine arch in a case of cancer. Fractures of this part have but slight tendency to displacement; the fragments are kept in place very firmly, and are acted upon by no muscular power. Ulcerations and perforations of different characters may occur; the latter are necessarily attended with a nasal accent and with difficulty of deglutition. Polypi also are sometimes situated in the gum, *epulis.* The maxillary sinus is generally opened in this place,

* The spheno-palatine, and even the nasso-palatine ganglion, discovered by H. Cloquet, are connected with the fifth pair.

at the alveolar process of the first great molar tooth which has been previously extracted, as this is the most sloping part of the sinus, which will be described when speaking of the malar region to which it belongs.

2. PALATAL REGION.

The arch of the palate, the soft palate of some writers, is a kind of valve, which, by its elevation or depression, may alternately leave the pharynx open or close it; it is suspended at the upper part of the pharynx, and is continuous with the palatine arch.

Its transverse extent has a relation with that of the palate, and its length is about five lines: its form is quadrilateral; it has two mucous faces, marked on the median line by the raphe, and continuous, one with the floor of the olfactory region, the other with the palatine arch; one of its edges, the superior, adheres to this; the other, the inferior, is arched on each side, and presents on the median line, the uvula. Its lateral portions are embraced by the pharynx, and give rise to the two pillars.

Structure.—1. *Elements.* The solid part of the velum palati is formed by a fibrous layer, belonging to the two circumflexus palati muscles, in which we find the levator palati mollis, the glosso, palato, and pharyngo-staphylinus muscles: the whole of the latter is situated in it, while the others only terminate there. The mucous membrane contains numerous glandular granulations, particularly near its loose edge. The arteries come from the superior and inferior palatine and pharyngeal arteries; the veins follow the same course; the lymphatic vessels go to the neck at the angle of the jaw. The nerves are given off by the small palatine and the glosso-pharyngeal nerve.

2. *Relations.* From behind forward, we find successively the posterior mucous membrane, a dense glandular layer; the palato-staphylinus muscle in the centre, and the two levator palati mollis muscles, united in a raphe before the latter; the aponeurosis of the circumflexus palati muscle, the extremities of the glosso-staphylini muscles, and the pharyngo-staphylini muscles, a new glandular layer, and the anterior mucous membrane.

Development. In the following article we shall find only the early development of the velum palati; this part is very short in the child; the uvula, particularly, appears as a mere rudiment; on the contrary it is often larger in the adult and the old man.

Varieties and uses. The velum palati is subject to varieties in its directions, connected with its motions, which are those of elevation, depression, and transverse tension; the object of some of these motions

is to prevent the food from ascending in to the nasal fossæ and eustachian tubes, during deglutition, while the others tend to depress it towards the lower part of the pharynx. They have also a marked influence on the voice.

Pathological deductions and operations. We shall pass over the deviations in the formation of the velum palati and the ingenious operation for its fissure. It is rarely wounded; it is sometimes divided to facilitate the extraction of polypi from the throat; this cannot be attended with severe hemorrhage. The velum palati may be partially or entirely destroyed by ulcerations; the uvula may be enlarged by a hypertrophy of its glandular layer, a hypertrophy similar to that of the amygdalæ, and may, by tickling the base of the tongue, produce a cough, which can be cured only by its amputation. The abundance of the mucous glands of the velum palati, explain those membranous secretions, which so frequently envelope it in children, when it is inflamed.

3. LABIAL REGION.

The lips, the anterior portion of the buccal parietes, are two movable bodies, which close the anterior opening of the mouth, or leave it open, as occasion may require. This region is separated inferiorly from the chin by the mento-labial groove, and from the malar region on the side by the naso-labial depression, which forms a curve concave anteriorly, and terminates imperceptibly towards the chin.

There are two lips, an upper and a lower. They are evidently perpendicular to the horizon, and are situated directly before the upper and lower gums, with which they are united by a mucous fold, termed the frenum. They unite on the outside to form the commissures. They have two faces; one of these is mucous, posterior, and concave, which presents the frenum, and is rendered uneven by numerous glands, which raise its internal membrane; the other is cutaneous and anterior, and presents at the upper lip a median depression, termed the infra-nasal, which is covered only with a slight down on the sides; the two layers are directed outward, and are covered in the adult with hairs, the mustachios: this face also at the lower lip, looks a little downward in every part: it is depressed on the median line, and in this point only, presents a small tuft of beard, in the male adult. The loose edge of the lips is mucous: the skin commences on the outside, following a line which curves in an opposite direction on the two lips, and in the course of this are situated numerous follicles, the labial, particularly near the commissures: this edge is red, projects on the median line, and is depressed

on the lower lip: it presents some antero-posterior grooves, which become very distinct when we attempt to contract the opening of the mouth, and by the mobility of which, the form of the lips can be very much varied.

Structure.—1. *Elements.* The lips are formed essentially by the skin on the outside, and by the mucous membrane on the inside, by numerous follicles and glands; by a circular muscle, formed principally by the termination of the buccinator muscle, the upper fibres of which pass into the lower lip, and the lower fibres into the upper lip, the central fibres being arrested at the commissure. Besides, the depressor ali nasæ, the quadratus, the zygomaticus major, the triangularis and the levator anguli oris terminate there on each side; the first in the upper lip; the second, exclusively in the lower lip, and the last three in the commissure. The levator muscles of the upper lip, and the zygomaticus minor muscle, do not come as far as this; they are bounded inferiorly, as we have frequently demonstrated, at the naso-labial fissure, as here they are inserted under the skin. The labial arteries come from the facial, and form a circle, which is completed on the outside by the trunk which supplies them: they thus establish an easy communication between the two facial arteries. We also find in the lower lip some twigs from the inferior facial artery and from the infraorbitar artery in the upper lip. The veins do not differ. The lymphatics all proceed to the submaxillary ganglions. The nerves come from the two sources already mentioned, *the facial and the fifth pair.* But little cellular tissue exists, and this is very soft: it contains but a small portion of fat.

2. *Relations.* The relations of the elements of the lips are very simple: at first, the skin which adheres very firmly and on which terminate many muscular fibres; a muscular layer formed by the orbicularis muscle, on the loose edge, the quadratus below, the depressor alæ nasi above; at the commissure, the zygomaticus, the levator and the depressor anguli oris united; they conceal the anterior part of the buccinator muscle; more deeply, the coronary arteries and the mucous membrane. We observe that the superior artery always follows the edge of the corresponding lip, while the inferior artery is situated only in the centre, and comes there, following the course of a line oblique from this point to the lower and outer part of this lip. Whenever a coronary artery does not exist on the portion of the edge of the lower lip, we always find a branch which anastomoses with it, and which comes from the facial or from the superior coronary artery.

Development. The lips are developed at a late period; from their absence in the early periods of life, the oral cavity is uninterruptedly continuous with the anterior plane of the face; when they appear, they

are both separated on the median line; at a later period, the raphe is formed; the upper lip as we shall see is only apparently an exception to this law. Some authors think that when the lips are first formed, they are, like the eyelids, united by the mucous membrane.

Simultaneous development of the upper lip, the palatine arch and the velum palati. The upper lip and the velum palati are moulded in their development on that portion of the palatine arch with which they are directly in contact. All this part of the buccal parietes is formed of pieces which are united in the median raphe; the posterior portion is formed of two, the anterior half of four; the two internal pieces of which the median raphe is formed, are united very rapidly with each other, and at a later period with each lateral segment. This evolution of the palatine arch is evident; the same is true of the upper lip, in which the pretended single point was at first double. We have dissected a fetus where the upper lip was cleft on the median line.*

Varieties. The lips of the European are generally situated in a perpendicular plane; they are oblique, and remarkably large in the negro. The size and direction of the lips also vary in the same races. The upper lip particularly is remarkable for its swelling in lymphatic subjects.

In a young child the lips are very much developed, and almost cross each other, which is necessary for suckling. When the teeth are formed, this proportional length diminishes. In the old man, they again become very long from the loss of the teeth, and the approximation of the jaws, they project forward and thus give the face a peculiar expression, and hinder mastication and articulation.

Uses. The lips possess in a great degree the power of contraction and of pouting.

Pathological deductions and operations. The lips are rarely absent; they are more frequently united abnormally, which requires a slight operation; these deviations of formation are explained very readily by the development of these parts; this is true also of their fissure, which constitutes hare-lip, this is rarely seen in the lower lip, where it is always situated in the centre; on the contrary, it is frequent in the upper lip, and there is then a simple or double fissure; when it is simple, it is seldom situated on the median line, which, however has been seen; it was then caused by a want of union of the two median segments of the lip; it is much more frequently lateral, produced by the want of union of the double median segment with one of the lateral segments. In the second case, if the solution of continu-

* In the hare and in all the gnawers, the upper lip is cleft on the median line, and we cannot assert that in them the development varies from what we have stated.

ity be double, there may be a median and a lateral fissure; but the two are generally lateral, on account of the too rapid union of the two small median points. This division may be confined to the lip, or it may extend to the palate, rarely upon the median line, and for the same reason. Sometimes one, and sometimes two divisions exist at the anterior part of the palate. In the latter case, it generally becomes simple, when it extends to the posterior part; but as the fissure anteriorly may affect only the lip, or this and the anterior part of the palate, so too, it often affects the velum palati posteriorly, or both this and the posterior part of the palatine arch. In these two cases, but one fissure exists, and this is situated directly in the centre. The effect of the development of the arch of the palate, on that of the lip and the velum palati is such, that the latter are moulded anteriorly and posteriorly on the former: this fact has been demonstrated in the normal formation, but after the operation for hare-lip, we have often noticed an opposite action of the lip on the divided palatine arch. The operation of staphyloraphy invented in our times, and almost simultaneously by two of the finest surgeons in Europe, Roux in France, and Græfe at Berlin, would doubtless furnish an opportunity for observing the same phenomena at the posterior part of the palatine arch. Unfortunately, however, as Roux has observed, staphyloraphy succeeds with difficulty, when the palatine arch is divided; this celebrated surgeon also proposes to attempt the union of the palate, either by making a lateral pressure on the superior dental arches, or by removing a portion of the soft tissue of the palatine region, on each side, and uniting them on the median line. This plan certainly seems practicable, but we fear it will fail, because the superior dental arches resting posteriorly on the pterygoid processes, do not seem capable of approximating by yielding to a lateral pressure, and also because the submucous tissue of the palatine arch is very dense, and might not admit the extension necessary to bring it to the point of contact, below the separation of the bone. The palatine arch together with the lip and the velum palati may be entirely deficient: sometimes there is a broad median separation, which unites the mouth and the olfactory region; then the apparently unmated anterior point of the lip and of the palate is not formed; we have observed that this defect generally co-exists with the absence of the olfactory nerve.

Wounds of the lips, notwithstanding the reasoning of Louis, cannot be kept in place, and consequently cured without deformity, except by the twisted suture. This depends entirely on the very great contractility in the transverse direction of these parts; their vascularity explains the frequent appearance of erectile tumors here.

4. MENTAL REGION.

The mental region, a small portion of the buccal parietes, is composed of the central portion of the lower maxillary bone, and of the parts which rest upon it anteriorly; its limits are well defined. It is united posteriorly to the floor of the mouth; it forms anteriorly a prominence which is generally bilobate, and on which the raphe is well marked: the latter is always covered in adult males with coarse hair, and is directed a little upward.

Structure.—1. *Elements.* The part of the inferior maxillary bone which belongs to this small region, presents the symphysis, the mental process, the mental fossæ, and posteriorly the genial processes. The depressor alæ nasi muscle, the quadratus menti, some fibres of the platysma: the skin, a compact cellular and adipose tissue, some arteries which come from the inferior dental, and the submental arteries, some similar veins, some trivial lymphatic vessels, some nerves from the facial and the fifth pair, are the other elements of this region.

2. *Relations.* All these parts are arranged in the following order: the skin, on which are placed the fibres of the depressor alæ nasi muscle, thus rendering it more fixed; a dense cellulo-fatty layer: a muscular layer formed by the two quadrati united on the median line, which layer is traversed perpendicularly by the fibres of the depressor alæ nasi: next comes the last named muscle, which is surrounded by a looser tissue of vessels and nerves; the whole rests on the maxillary bone.

Development. The chin apparently is at first cleft: in children and in old men it is very prominent and is curved upward: in the adult it is much less so.

Varieties. This region presents many individual varieties which are of no importance.

Pathological deductions and operations. Wounds of the chin are common, but fortunately they are not very serious, excepting however its fractures. In fractures of the jaw, and particularly in those produced by a counterblow, the fracturing force acts through the chin; the chin has sometimes been paralyzed after these injuries, when they were complicated with a laceration of the dental nerve. The organic affections of this region are usually consequent upon those of the lower lip: they sometimes require its removal, and particularly that of its skeleton: Dupuytren and Delpech, have been very successful with it: Græfe of Berlin has gone still farther, and has had the boldness to extirpate the whole maxillary bone. The amputation of the bony part of the chin requires the previous removal of the soft parts of the

floor of the mouth, except in some cases where the superficial part of the bone only is to be removed. The lateral sections of the jaw must always be made obliquely from behind forward, and from without inward, in order to afford the least possible chance of separation between the fragments, and more opportunities for the formation of an intermediate fibrous or cartilaginous substance.

5. MALAR REGION.

The malar region forms the lateral wall of the mouth; its bounds on the outside are less exact than on the inside. In the first direction, the lower and posterior edges of the lower jaw separate it from the parotid and supra-hyoid regions; the zygomatic arch, and the base of the orbit above, separate it from the temporal and inferior palpebral regions; while forward, the curved naso-labial groove, which we have already mentioned, distinguishes it from the lips.

The malar region is quadrilateral, and its surface is much greater than its thickness; in this latter dimension, the posterior part exceeds the anterior. Farther, it presents two faces; one is cutaneous, the other mucous; the first is generally convex and downy; its most prominent point corresponds to the malar bone and forms the cheek, which is remarkable for the fineness and beauty of the skin which covers it; at its central part there is often a depression which varies in depth; we must distinguish it from another which is situated anteriorly, and which females consider a beauty. The mucous or internal face is smooth in most of its extent; it is attached only above and below. At the place where this adhesion commences, there is a groove which is continuous with that behind the lips, and which may be termed the genio-maxillary groove. This face of the malar region presents in its loose portion some prominences which belong to the buccal glands; the opening of the duct of Steno, which is directed obliquely forward and inward, and corresponds with the level of the second upper great molar tooth, three lines from the upper genio-maxillary groove; a depression opposite the first of these on the outside, which depression is bounded posteriorly by a mucous fold which extends between the upper and lower alveolar edges, and is situated below the ramus of the jaw.

Structure.—1. *Elements.* The structure of the malar region is very complex: it is composed of very different elements. Its skeleton is formed by half of the lower maxillary bone, the external part of the upper maxillary bone, and the malar bone; the first is grooved below by the inferior dental canal; it is partly opened at the mental foramen, and communicates with the base of the alveolar processes by small

channels; the second presents on its surface the canine fossa, the infra-orbitar foramen, and internally the *maxillary sinus*, a pyramidal cavity, which corresponds anteriorly to the preceding fossa; above to the orbit, below to the summit of the alveolar processes of the molar teeth, and particularly those of the third and fourth, which sustain this wall; posteriorly to the malar tuberosity, inward to the internal nasal region and particularly to the nasal canal forward, backward to the middle meatus in a point where it is opened as has already been mentioned.

The masseter, the pterygoideus internus, and the buccinator muscles are the largest in this region; the zygomaticus major, the triangularis, some fibres of the platysma, of the orbicularis palpebrarum, and of the levator anguli oris muscles, the levator labii superioris proprius, and the zygomaticus minor muscles are confined to the malar region, and terminate in the curved nasolabial groove; the malar region is strengthened in its weakest part, at the buccinator muscle, by an aponeurosis which has not hitherto been described; this layer, which may be termed the genial, is formed of one fold anteriorly, and of two posteriorly; one of them rests directly on the buccinator, is generally considered as an expansion of the external membrane of the duct of Steno, and is very distinct from the pharyngo-buccal aponeurosis, the description of which does not belong to our subject; the other separates from the buccinator muscle, and is inserted on the anterior edge of the ramus of the lower maxillary bone; two anterior prolongations of the parotid gland proceed, one superficially, the other deeply into the malar region; the first, the larger, often forms a distinct lobe of the gland, and is furnished with a secretory duct which goes to the duct of Steno; the second is situated between the ramus of the jaw and the pterygoideus internus muscle. This arrangement of the parotid gland, in respect to the ramus of the jaw, resembles that of the sub-maxillary gland on the loose edge of the mylo-hyoideus muscle. The parotid canal passes through the malar region horizontally from behind forward, at the union of the upper with its two lower thirds, and then terminates at the outer part of the middle depression mentioned above; it forms also in front of the masseter muscle, a curve convex anteriorly, it passes obliquely through the different layers of this region, appears under the mucous membrane, and perforates it at the place mentioned. The malar arteries may be divided into the superficial and deep: the first come from the facial and from the transverse facial artery, the second are given off by the internal maxillary, and particularly by its infra-orbitar, alveolar, masseteric, pterygoid, buccal, and inferior dental branches; all anastomose frequently with each other, and communicate with those of the

orbit. The veins follow the course of the arteries, and differ from them in having fewer curves; the superficial and the deep veins communicate by broad branches, which are often so much developed that they may be considered as trunks, which unite and form the anterior internal maxillary vein of Meckel. The lymphatic vessels of the malar region are divided between the parotid, the sub-maxillary, and the deep cervical ganglions. The nerves come exclusively from the two sources mentioned when speaking of the mouth, the facial nerve and the fifth pair; the filaments of the first have a transverse or oblique direction; some are buccal, the others malar; the filaments of the second are perpendicular or oblique, the buccal, the masseteric, and the dental branch of the inferior maxillary nerve, the infra-orbitar and the alveolar branches of the superior orbitar: the lingual and the superficial temporal nerve only pass through this region. The skin and the mucous membrane present nothing more than what we have stated; the first is remarkable for its fineness and for the vascular net-work which it contains. But little cellular tissue exists anteriorly; the contrary is true posteriorly; so too with the adipose tissue which is divided by the genial aponeurosis into two distinct masses, one of which is superficial, the other deep; they have opposite states of development.

Relations. The relations of the malar region are very complex and important; in order to mention them distinctly, they must be traced successively in three parts, the cheek, the masseteric, and the inter-maxillary portion.

1. *Cheek.* The finest, and most vascular skin of the cheek forms a first layer, and rests on a small quantity of cellulo-fatty tissue; next comes a prolongation of the orbicularis palpebrarum muscle, which conceals posteriorly, the origin of the zygomaticus major, and anteriorly that of the zygomaticus minor muscle, inferiorly the transverse facial artery and also some malar filaments of the facial nerve; these filaments are distributed in the preceding muscles, particularly the zygomatici, and anastomose with some minute ramifications of the fifth pair which emerge from the malar foramina.

In the *masseteric* portion, there is more cellulo-fatty tissue directly under the skin in the cheek; we also find there some fibres of the platysma myoides muscle; a layer is then distinctly formed, first, by the anterior edge of the parotid gland, under which we see the buccal filaments of the facial nerve; second, by the duct of Steno, which has a transverse direction below the prominent edge of the malar bone, and which is covered by a large filament of the facial nerve, and by the distinct lobe of the parotid gland, the small parotid gland of some writers; third, above, by the upper extremity of the zygomaticus major muscle; more deeply

appears the masseter muscle, concealing the masseteric vessels and nerves, the ramus of the jaw, its coronoid process, the neck of its condyle and the sygmoid fissure, on which the deep masseteric vessels and nerves rest. Under the bone we find, directly below, the lingual nerve, the myloid filament of the inferior dental nerve, and the pterygoideus internus or the masseter muscle; this latter is separated from the maxillary bone, which is above it, by a space, which contains, the internal maxillary artery and its first branches, the inferior dental and the superficial temporal nerves at their origin, the internal lateral ligament of the temporo-maxillary articulation, this latter separating the parts we have named from the lingual nerve of the fifth pair.

3. *Intermaxillary portion.* When we have removed from this space, the skin, the subcutaneous cellulo-fatty tissue, and the filaments of the facial nerve which are there distributed in every part, we discover successively; above, the orbicularis palpebrarum muscle; the facial vessels, the vein being a little on the outside of the artery; the zygomaticus minor and the proper levator of the upper lip; the infraorbitar vessels and nerves, the levator anguli oris muscle and the canine fossa; the upper maxillary bone and the antrum Highmorianum, containing in its anterior wall the anterior dental vessels and nerve; in the centre, the zygomaticus major muscle proceeding towards the commissure, on the outside of which it unites with the levator and the depressor anguli oris muscles, covering directly the facial artery and also the buccinator muscle, from which, however, it is separated posteriorly by some adipose tissue in which the duct of Steno penetrates transversely at the upper part; second, by the facial vein, which ascends near the masseter muscle, and is at least one inch distant from the facial artery; third, by the genial aponeurosis, which is single forward, and contains posteriorly, between its layers, some adipose tissue; finally, by a great number of malar glands, the buccinator muscle forming a very simple layer, below which the mucous membrane is seen; below, the facial vessels, the vein always on the outside of the artery, both resting directly on the bone, before the masseter muscle, and behind the depressor labii inferioris and the quadratus muscle; finally, this last conceals the maxillary bone, the mental foramen, and also the mental vessels and nerves.

Development. The malar regions are very slightly developed from before backwards in the embryo; they are at first deficient; during fetal life and early infancy, they bulge out very much, which depends on the absence of the teeth which admits the approximation of the jaws, and on the considerable development of the fat on the outside of the aponeurosis. Bichat has shown that this fat forms a rounded mass which is very remarkable, and, as it were, lipomatous. This

fulness continues for a long time, although it gradually diminishes; in the adult, it is replaced by the external depression which has been mentioned; the absorption of the superficial fat, while the deep seated fat remains, accounts sufficiently for this change in the external form. In the old man, the fat diminishes, although the cheek does not fall in proportionally, which depends on the approximation of the jaws by the loss of the teeth: this approximation throws the cheeks outward, and leaves them very flaccid. In the fetus, the malar region is triangular: its parotid edge blends with the lower edge; when the teeth are developed, it gradually assumes a quadrilateral form, while its lower and posterior angle approaches a right angle. In the old man, the cheek again becomes triangular, even when all the teeth are lost. Let us carefully remark this influence of the teeth on the angle of the cheek; this physiological fact has served for the base of some operations. After the period of puberty, the hairs of the beard appear on the malar region of the man, and in the two sexes, this assumes its agreeable color. This color of the cheek disappears in the adult age; but a violet and striated redness of the small vessels succeeds, which Beclard thinks is owing to the dilatation of the capillary veins. In children, the maxillary sinus scarcely exists; it gradually forms as age advances, and often extends into the malar portion; its parietes become thin, and, as it were, transparent.

Varieties. In the female, the malar bones and the masseteric portion of the region are less prominent than in the male; the superficial fat is more abundant; hence a more graceful roundness, which is hardly interrupted by a slight groove anteriorly; the skin is covered with a slight down, the whiteness of which contrasts in some parts with the freshness and brilliancy of its color in others.

The zygomaticus minor muscle is often deficient, and the orbicularis palpebrarum muscle sometimes descends very low; sometimes the masseteric artery does not exist, and is replaced by the enlarged twigs of the transverse facial artery.

Physiology. The malar region forms one of the buccal parietes; for this purpose it has a proper resistance, derived from different layers, particularly from its aponeurosis; it also executes two kinds of motions, some belonging to the functions of digestion, the others to those of respiration. Charles Bell and Shaw have proved by their experiments, that the first depend on the nerve of the fifth pair, and the second on the facial nerve; a noble discovery, which has thrown great light on the physiology of the cheek. The motions of the cheek which are connected with digestion are, first, those which have for their object the reception of solid or liquid food; second, those of mastication, in which the buccinator muscles push the food between

the jaws, which are brought together and rubbed against each other; third, those of deglutition, and fourth, finally, those by which we manifest the want or the desire of taking nourishment. The respiratory motions of the cheeks are manifested in gaping, in blowing, and in the passions which affect the whole respiratory system, and particularly the malar region. These last modify extremely the expression of the face; the cheek then becomes the mirror of the soul; when the feelings are gay, it is drawn upward and outward; but when the mind is sad, obliquely downward. In these motions, the anterior portion is always drawn toward the other parts, the curved naso-labial groove being the true moveable point; the insertion of several small facial muscles near it, satisfactorily explains these phenomena. When the impressions received are slight and trivial, they leave no trace upon the cheek; but when serious, they produce deep and permanent grooves; hence two characters, by which the moralist and physician may immediately recognise the mildness or the violence of the passions. In the young child, the cheek which at nearly the same instant is alternately moistened with a tear and decked with a smile, preserves in the healthy state that roundness which marks this happy age. In the adult, on the contrary, the cheek always presents more or less distinct wrinkles; this arrangement is still more apparent in old age, because the old man is cross and fretful; in the old man, however, we must not consider as marks of the passions, those wrinkles caused, as has been said above, by the approximation of the jaws. Lavater thinks that the sentiment of the physiognomy is situated in the cheeks; as a proof of this, we have only to examine comparatively, the base and jealous man, with him who is generous and noble. The color of the cheeks also varies much in the passions; it is important to determine the physiological origin of these changes of color. Sometimes, as in fear or envy, the cheek is pale and colorless; sometimes, as in love and anger, it is uncommonly red. These different states result from the immediate and certain action of the passions upon the circulatory and respiratory systems, which are influenced reciprocally so much as to be always excited simultaneously. The changes in the cheek which affect the expression, like the respiratory motions, depend particularly on the influence of the facial nerve; children and females, in whom the nervous system is generally more susceptible to impressions, also present in the greatest degree these more or less transient modifications of the cheek.

Pathological deductions and operations. The cheeks are very much changed in diseases, and the physician must carefully attend to these changes; but this will be difficult unless he continually bears in mind our views of the healthy state of this region. These modifica-

tions constitute the morbid expressions of the face, the best description of which is imperfect, and which should be studied at the bedside of the patient; all good physicians admit, that this study can furnish signs of internal diseases, which, if not certain, are at least very advantageous. Those who neglect or seek to ridicule this mode of investigation, prove only one thing, that they study pathology without a proper knowledge of anatomy and physiology, upon which the former is founded.

The action of stimulants upon the digestive and respiratory systems are, as we have seen, even in the healthy state, marked upon the cheek by peculiar expressions. Being stronger in the morbid state, ought they not to cause a similar but forced expression? The shrinking of the face, and particularly of the cheek, in abdominal affections, the bright color of the cheek in the thoracic affections &c., all prove the affirmative of this question. The morbid expression of the face, then, is extremely useful, and often the only guide of the physician in a very young child, who can tell nothing in regard to its sufferings; happily also, the cheek, at this age, has not been altered by the passions, so that its morbid changes represent exactly the diseases of the internal organs; in the adult and the old man, the conditions of the healthy state are entirely changed, and render the morbid expressions of the face more difficult of observation, and less important, although, in many cases, they are extremely useful to the enlightened physician.

Wounds of the malar region may be complicated with a hemorrhage which may come particularly from the facial artery; this accident is of little importance, because the vessels of the malar region are easily tied. Farther, the arteries of this region are so numerous, and open there by so many points, that the edges of the wounds bleed in every part. When the wounding instrument is carried backward on the masseteric portion, the canal of Steno may be affected; the lesion of this in front of the masseter muscle is more difficult, because it is situated more deeply there: we remark, however, that in the first point, this canal being situated under the projecting edge of the malar bone and the zygomatic arch, has often been protected by it. A Gendarme whom we attended, presented a remarkable instance of this fact: he had received in a duel a sabre wound, which was vertical, penetrating above on the malar bone, and below into the masseter muscle, which was injured; the salivary duct, however, was only crowded back, and the wound cicatrized promptly without the formation of a fistula. Nevertheless, the wounded are often less fortunate, the wound is then more serious, and a fistula will be formed if the patient does not receive medical assistance. Percy regards this unfortunate result

as rare, founding his opinion upon the great number of wounds of the cheeks which are perfectly cured. Boyer is of an opposite opinion, which we can adopt much more readily, as the fact which has been mentioned, and the anatomical arrangement of the canal of Steno, establish, that in most of wounds cured without a fistula, according to Percy's remark, there was no injury of the excretory duct. The fistulæ caused by these wounds may be external or internal: the first are the only ones to be feared; the second are attended with no inconvenience; they also point out to the surgeon the mode of preventing or curing the others. Does a wound affect the whole cheek? its lips are separated inward, while they unite externally. If the wound, on the contrary, or the fistula, be only external, we make an incision on the inside of the mouth with a bistoury, and the same course is adopted, as in the first case, for the internal dilatation, and the union of the skin.* Lewis and Morand have proposed to introduce an instrument into the duct of Steno to dilate it in some cases: this operation is difficult, from the oblique direction of the buccal extremity of this passage, and from the curve it forms before the masseter muscle; to avoid these obstacles, Lewis states, that we must introduce the fingers into the mouth, raise the cheek and draw it forward. Boyer remarks, that in children, the superficial button of fat often projects between the lips of the wounds. Some bruising bodies may produce fractures of the skeleton of this region, and may enter the maxillary sinus, and by continuing there may cause bad symptoms. Fractures of the upper jaw are not in themselves very dangerous, but as they are generally attended with a more or less serious concussion of the cerebrum, they are more important than fractures of the lower jaw: when these are oblique, the fracture is generally directed downward and backward, which facilitates the depression of the anterior fragment by the muscles of the supra-hyoid region. The fracture may occur in the centre of the body of the bone, near the angular insertion of the masseter and pterygoideus internus muscles, or finally, at the neckof the condyle. In the first case, while the mental fragment is displaced, as we have mentioned above, the posterior rests against the upper jaw, being kept there by the masseter and pterygoideus internus muscles; in the second case, these two muscles prevent all displacements, because being attached to the two fragments, they act upon them equally, and in the same direction; finally, in the third,

* Deroi and Duphœnix made but one internal opening; they were obliged to retain a thread in the external part of the wound to keep in place the dilating body on the inside. Deguise has improved this method, by proposing to make two internal openings, through which the two extremities of the dilating body can be brought into the mouth, and be attached without an external thread.

the upper fragment alone is displaced and goes forward, obeying the action of the pterygoideus externus muscle. The laceration of the dental nerve in fractures of the jaw, attended with great displacement, has sometimes produced tetanus, or a paralysis of the chin. The nervous and vascular communications between the cheeks and gums, and their direct relations, establish a mutual dependance between these two regions; in fact, if the malar region be affected by cold, it swells first, and then the teeth become painful; if the latter be affected primitively, the malar region often becomes the seat of a phlegmon, which is termed a fluxion, and which may present all the terminations of this disease; when the pains in the teeth and consecutive swelling are caused by caries, this often terminates in an abscess, and also in a fistula, which differ from the salivary fistulæ mentioned before. Severe pains sometimes extend to the cheek in different directions: sometimes they emanate from a point near the lower eyelid and descend toward the nose and the lips; this is *infraorbitar neuralgia;* sometimes they commence at the chin and ascend toward the cheek, this is *mental neuralgia;* in other cases, the pains extend from the parotid to the malar region, following transverse and slightly oblique directions; this is *facial neuralgia.* These affections, which are termed tic douloureux of the face, are sub-acute or chronic: they may be more or less intermittent: the affection of the facial nerve is more common than of the others, and habitually produces, during its access, a redness of the corresponding cheek, which contrasts with the paleness of the opposite side; this phenomenon is connected with our remarks on the influence of the diseased nerve on the color of the cheek. The division and even the removal of a portion of the affected nerves have been attempted in several cases, by many distinguished surgeons, and particularly by Roux, but always with transient success; this professor has divided successively, in the same individual, the infra-orbitar, the mental and facial nerves, thus pursuing constantly a neuralgia which fled before his knife, and which was finally seated in the ramifications of the buccal branch of the inferior maxillary nerve;* in consequence of these neuralgias, the muscles are sometimes paralyzed. I know a lady in whom the facial nerve is

* When the facial nerve is affected with neuralgia, remedies must be applied to it in the parotid, and not in the malar region, which course is prescribed by anatomical reasons, to be stated hereafter. The incision necessary in dividing the infra-orbitar nerve, will embrace necessarily; the skin, a cellular layer, the orbicularis palpebrarum muscle, and the levator of the upper lip. The incision for the submental nerve may be made on the inside, and then would interest only the mucous membrane; if made, on the contrary, on the outside, we must divide the skin, the depressor anguli oris, and the quadratus menti muscles: the inferior labial artery also might be affected, as is proved by the relations mentioned.

alone affected; the malar region preserves its power of mastication, but has lost its expression; in smiling, particularly, it is curious to observe the singular contrast on the two sides of the face: one presents very various motions; the other is perfectly still. These facts support the celebrated experiments of Charles Bell.

Among diseases of this region we shall briefly mention, gangrene, which so often affects the cheeks of infants, and proceeds from the mucous to the cutaneous face. Tumors of different kinds may appear in the malar region; those formed by the erectile tissue are very common, as might be presumed from their vascularity of the part, independent of experience; their extirpation is often attended with but little deformity, even when a great portion of this region has been removed, because the rest readily yields: in every case, in order to favor this tendency, and to facilitate the union of the wound, the cheek should be separated for some distance from the jaws, by cutting the fold, formed by the passage of the mucous membrane, near the gums. Some tumors of the jaw are produced by exostoses, which arise from its skeleton, and others simply by the dilatation of the maxillary sinus. This sinus may be considerably enlarged, when a polypus, pus, or serum forms in its cavity; but these foreign bodies depress the anterior wall particularly, and act but slightly upon the others; sometimes also, but rarely, the olfactory wall of the sinus is destroyed, and its cavity blends with that of the nasal fossæ; more frequently, its anterior wall becomes considerably thinner, and wastes; the soft parts of the cheek then envelope the tumor, which may also be felt in the mouth under the mucous membrane; sometimes the molar teeth are loosened, or the floor of the sinus is crowded on their roots, and soon perforated by them: even the pressure of a fluid, acting directly and for a long time on their point, has curved it and riveted it internally: in other cases, fistulous openings form on the alveolar edge, and serve for the discharge of the morbid fluid accumulated in the maxillary sinus, thus pointing out to the physician the course to be pursued, to relieve the patient promptly; the puncture of the maxillary sinus is the operation for the cure of these diseases. The place selected for this operation is the lowest part of the sinus, which corresponds to the alveoli of the first and second great molar teeth: farther, its wall in this part is formed by a very thin plate of bone. In order, however, to save the teeth, if any exist, Desault advises to perform it on the anterior wall of the canine fossa, after separating the soft parts of the cheek; Lamorier also mentions the molar tuberosity as the most proper point; but if we follow the advice of these celebrated surgeons, anatomy demonstrates, that the consecutive suppuration, which must necessarily occur, would only take place in part, and the disease would not be

cured. Ribes has related very curious instances of military men, who have survived the loss of the lower part of the cheeks, and of nearly the whole lower maxillary bone; a frightful mutilation, which, by displaying the immense resources of nature, has pointed out the course to be followed in deep affections of the malar region, attended with disease of the lower maxillary bone: in this case the bone must be partially or even entirely removed, as has already been stated.

6. TONSILLAR REGION.

The amygdala or tonsil and the surrounding parts form a small region, which is more important in a pathological than in an anatomical point of view: it forms, with the pharynx above and the base of the tongue below, the isthmus of the fauces, the *bucco-pharyngeal opening*. The tonsillar region is smooth and mucous on the inside; it is bounded anteriorly and posteriorly by two folds, the pillars *of the velum palati:* it is depressed in the space between them, and is marked by several openings which lead into the lacunæ of the amygdalæ: its external face bounds the carotid space, and at the interval between the horn of the hyoid bone and the angle of the jaw, the vessels of this space rest directly against it.

Structure.—1. *Elements.* This region is formed principally by the amygdalæ. Its different granulations pour the products of their secretion into the common lacunæ, which open on the mucous membrane: these lacunæ may be considered as the rudiments of excretory passages:* two muscles belong specially to this region, the glosso-, and pharyngo-staphylini muscles, and also a small portion of the constrictor pharyngis superior muscle; its arteries are large and numerous; they come from the inferior palatine and pharyngeal, and from the lingual and the superior palatine arteries; the veins empty into the pharyngeal venous plexus, while the lymphatic vessels terminate in the submaxillary ganglions: the nerves of the tonsils come from the glosso-pharyngeal nerve, and from the upper cervical ganglion of the great sympathetic nerve: we have looked in vain for those branches, which some authors say come there from the lingual and hypoglossal nerves. All these nerves form a small plexus, improperly termed the *circulus tonsillaris.* The mucous membrane presents nothing remarkable.

2. *Relations.* From within outward, the mucous membrane forms the first layer: it is supported anteriorly and posteriorly by the glosso-staphylini and pharyngo-staphylini muscles: between them it belongs to the tonsil, and penetrates into its lacunæ; finally, we find more deeply

* The amygdalæ and some other organs, form the transition between the follicles and the glands.

the constrictor pharyngis superior muscle, and we arrive at the carotid region and the vessels situated in it. *Uses.*—A mucous substance constantly exudes from the surface of the tonsil, and lubricates the inner face of this region, and thus facilitates the passage of the food to the narrow opening of the isthmus of the fauces.

Pathological and operative deductions. In inflammations of the tonsils, the patient always presents a more or less remarkable tumefaction below the angle of the jaw: this is the part on the outside to which this region corresponds, and also the part where the ganglions, to which the lymphatic vessels proceed, are situated: in these cases, the ganglions are swelled sympathetically: a swelling is also seen on the inside, and then the amygdalæ project beyond the staphyline pillars; sometimes abscesses even form in them, which must be opened, being careful not to introduce the instrument too deeply, lest the important parts in the carotid space be injured: for the same reason, the extirpation of the tonsils has been condemned; these glands, when tumefied, should be removed only as far as the pillars which circumscribe them. Beclard, in his course of lectures, mentioned a case where the internal carotid artery was opened, and the patient died: this was doubtless done by some surgeon ignorant of the anatomical relations of the parts. In certain affections of the throat in children, the buccal surface of this region is covered with a membranous concretion, which Bretonneau states is often confounded with eschars: the vascularity of this part of the isthmus of the fauces, explains the intensity of its inflammations, and their different consequences. Celsus speaks of calculi in the amygdalæ; they are not unfrequent.

PARAGRAPH THIRD.

OF THE ORBITS.

The orbits are bony cavities, in the upper sides of the face, which contribute to the base of the cranium: they are designed to protect the apparatus of vision, and form a region which not only presents exact limits, but those also formed by nature for a very important physiological purpose; the anatomy of this part also, considered as a region, has long been studied: nevertheless, we shall make it the subject of important remarks.

The orbitar group is composed of two orders of organs: some are placed in front of it upon its base, while others occupy its cavity: hence two regions, an *external* and an *internal orbitar* region. The former is composed of the *tutamina oculi* of Haller; the latter of the globe of the eye, and its motory organs. Both are intimately connected

with the brain by their vascular system, and are separated by the olfactory region.

Development. This part of the face is one of the first which appears in the fetus: its internal portion forms first, the external afterward.

Pathological and operative deductions.—The regular development of the orbitar organs is subsequent to the formation of the median region which separates them: hence, when this is not formed, the two orbits are blended on the median line: this deviation of formation doubtless gave rise to the fable of the *cyclopians.* This anomaly presents many degrees; the lowest is marked by the existence, in one very broad orbit, of all the parts which are situated in the normal state on the right and left sides. In other cases, there is but one eye and one orbit; but it always presents marks of the union of two in one. Tenon and T. Bartolini have each mentioned a case of the union of the orbits, and the absence of the eyes.

The vascular communication of the orbitar parts of the face with the cerebrum, accounts for the redness of the eyes, and for many other symptoms of cerebral diseases; it also explains reciprocally, affections of the cerebrum or of its functions, in diseases of the eyes.

PARAGRAPH FIRST.

EXTERNAL ORBITAR RECION.

The external orbitar region is separated on the inside from the nasal region, by the naso-palpebral groove, and is bounded in the rest of its circumference by the base of the orbit, which is easily felt by depressing the soft parts; it is formed by two small secondary regions, the *eyebrow* and the *eyelids.*

1. *Eyebrow.* This small mated region is covered with hairs, rests on the orbitar arch, is arched and convex upward, and its limits are marked by the termination of the hairs. The two eyebrows often blend at their inner extremity, the *head;* the outer extremity, the *tail*, extends to the temple.

Structure.—1. *Elements.* The supraciliary arch of the frontal bone forms the skeleton of this region, to which, consequently, the frontal sinuses correspond, cavities lined by a part of the pituitary membrane, which receives its vessels from the external part of this region. The corrugator supercilii muscle is the only special muscle of this region, the occipito-frontalis and orbicularis muscles are partially connected with it, one to elevate, the other to depress it: the skin is covered with hairs, the color of those of the head, which are inserted perpendicularly on the inside, and obliquely in all other parts: we find there but little fat and adipose tissue. The nerves are principally twigs of the

external and internal frontal nerves, and of the facial nerve: the trunks of the first two, pass through the eyebrow. Most of the arteries are given off by the ophthalmic, and but few by the temporal artery. The veins and lymphatic vessels present nothing peculiar.

2. *Relations.* The skin, the first layer of the eyebrow, adheres more firmly above than below, particularly on the outside, because the fibres of the corrugator supercilii muscle are inserted in it in this part. The subcutaneous layer is dense and a little fatty at the upper part; it covers a first muscular layer, resulting from the union of the frontalis and the orbicularis muscles, a layer through which the fibres of the corrugator supercilii pass obliquely outward, and go to the skin. Below, we see this latter muscle, which rests on the nervous and vascular trunks of the region which are placed at the union of its inner with its two outer thirds; the external frontal nerve is situated farther outward: finally, we come to the orbitar arch, and the frontal sinuses.

Development. The eyebrows are destitute of hairs, until the sixth month of pregnancy; they project but little in early life, on account of the slight development of the frontal sinuses; in the adult, and particularly in the old man, they rise considerably above the orbit for an opposite reason.

Pathological and operative deductions. Wounds of the eyebrows may be serious, as has always been admitted; sometimes they cause death, sometimes amaurosis: fractures of the base of the skull by a counterblow, with which they are often attended, explain the first; the second has long been attributed to an injury of the supra-orbitar nerve: an explanation which has been rejected, but which, however, is more admissible, as Magendie has demonstrated that the fifth pair of nerves has a remarkable effect on vision. Some fractures of the supraciliary arch, with a depression of the anterior wall of the frontal sinuses, have sometimes been mistaken for lesions of the entire skull, with a depression of the fragments towards the cerebrum: their worst consequences are fistulæ of the sinuses admitting air. Tumors containing hairs are not unfrequent in this region; these are follicles morbidly developed. We may be called upon to divide the supra-orbitar nerve in this region, in case of frontal neuralgia; this is easily found where it emerges from the supra-orbitar foramen, by making below the eyebrow a curved incision concave downward; we must not forget, in this trivial operation, the variable position of the external branch of this nerve.

2. The eyelids are two moveable folds, situated in front of the ocular region, which open and close to admit or exclude the light. They are distinguished into upper and lower; they differ very slightly; hence we shall describe them generally, and point out their differences afterward.

General description.—The eyelids in man are placed in a perpen-

dicular plane: they unite on the inside and outside, in two commissures; *the one is the internal, the nasal, the great angle of the eye: the other, the external, the temporal, the small angle of the eye.* They have an anterior face, which is cutaneous, smooth, and convex, and presents more or less distinct semicircular folds; a posterior face, which is mucous and concave, loose at the centre, and attached at the edges: their circumference is continuous with the nose, the temple, the eyebrow and the cheek, at the points mentioned when treating generally of the external orbitar region; their loose edge is flat, according to Magendie; it is curved in its external five sixths, and is horizontal near the great angle. In the first point are curved and very coarse hairs, the *eyelashes*, and also the orifices of the meibomian glands, the *ciliary follicles:* in the second it is smooth, and has no follicular openings: near the place where the direction of this edge changes, it rises in a perforated tubercle, the *punctum lachrymale*, which is directed backward and inward, forming the upper orifice of the lachrymal canal.

Structure.—1. *Elements.* Not to mention the base of the orbit, which supports on the inside the lachrymal sac, and on which the eyelids rest, the latter owe their resistance to the tarsal cartilages, and to the fibrous palpebral membrane, the *broad ligament* of some authors; of which membrane the tendon of the orbicularis muscle is only an addition; the orbicularis muscle is the only one common to the two eyelids, and almost the only one in this region. The lachrymal canal passes through each eyelid, commencing at the punctum lachrymale. The skin of this part is remarkably fine, as is also the case with the mucous membrane, which does not line the whole of this region, but leaves it and goes upon the eye: this forms the ciliary follicles, which are situated perpendicularly, and open at the place mentioned. But little cellular tissue exists in the eyelids, and it is loose; fat is situated only at the posterior part. The arteries belonging exclusively to this region are the palpebral branches of the ophthalmic artery, which anastomose with some branches of the facial, the temporal, the infraorbital, the supraorbital, and the lachrymal arteries. The veins follow the course of the arteries. The lymphatic vessels are very numerous, and most of them go to the parotid ganglions: a few follow the facial artery, and go to the submaxillary ganglions. The nerves are twigs of the facial nerve, and of the fifth pair, the latter come specially from the ophthalmic nerve of Willis, and from the superior maxillary nerve.

2. *Relations.* The eyelids are composed of distinct layers, the first of which is formed by the skin: the second by a lamellar cellular tissue, moistened by an abundance of serum, and never containing fat: next comes the orbicularis muscle, separated by the palpebral arteries from the broad ligament and from the tarsal cartilages; more deeply, a cellulo-

fatty layer which is very abundant near the circumference, and is continuous with that of the internal orbitar region, but is slight near the loose edge where it covers the conjunctiva ; this membrane is then attached to the tarsal cartilages, on which it constitutes the meibomian glands. The relations of the external angle of the eyelids present nothing peculiar; this is not the case with those of the great angle : the skin is finer there than in any other part, and shows the subjacent network: below it is a cellulo-vascular layer, then the tendon of the orbicularis muscle, and the fleshy fibres which arise from it, the anastomosis of the facial and ophthalmic arteries, and also that of the ophthalmic and angular veins: more deeply, we see the fibro-mucous membrane of the lachrymal sac, *the upper part of the nasal canal*, rising a little above the tendon of the orbicularis muscle, and receiving the lachrymal canals ; the latter are situated at first under the mucous membrane, afterwards in the centre of the cellular tissue which surrounds the lachrymal sac and is continuous with that of the orbit.

Development. The eyelids are not visible until the tenth week, either because they do not exist, or because they are transparent, as many think: their base is formed first, and they increase towards their loose edge: at the twelfth week, according to Meckel, their opposite edges touch, and unite by their mucous layer ; at the same time they increase in thickness, and remain united till birth; this state continues even longer in some animals. In early life, the fibro-mucous, and osseomucous parts of the lachrymal canal have an inverse extent, on account of the slow formation of the bone; the latter is slightly developed, the first, on the contrary, predominates.

Characteristic differences of the eyelids. These are few, and affect the external form, and the structure, but not the development. The upper eyelid is alone connected with the eyebrow; its loose edge forms a plane, which is oblique downward and a little backward, describing a curve concave downward; that of the lower eyelid has an opposite direction; the eyelashes are arched upward in the former, and downward in the latter. The superior punctum lachrymale is directed downward, the inferior looks upward. The superior lachrymal canal is at first directed upward, but curves once to go downward and inward : the inferior, on the contrary, changes its direction twice ; at first it descends perpendicularly, and then is directed inward and upward, and again descends, after being united to the superior.

The upper eyelid alone possesses a levator muscle, which we shall study in the internal orbitar region ; this part is situated directly behind the broad ligament, between it and the mucous membrane; we add, that this latter ligament is stronger superiorly, that, on the contrary, the orbicularis muscle is more developed inferiorly.

Pathological and operative deductions. The eyelids may be deficient, or they may continue united after birth, and then a slight operation is necessary. Wounds of this region are often extremely serious, not on account of the injury of the layers which belong to them, but in those of the upper eyelid, from the fracture of the base of the skull, either directly, when the wounding instrument has penetrated deeply, or by a counterblow, if the orbitar edge has been struck with violence. The wounds made voluntarily in this region in surgical operations must be curved as much as possible in the direction of the folds of the eyelids, between which, the cicatrix is afterwards concealed. The loose edge of the eyelids may be turned inward or outward, *entropion, ectropion*, when the skin and the conjunctiva are unequal in length. In the former case, the mucous membrane is shorter than the skin, either because the former is contracted or because the skin is relaxed : in the second case, either the skin is shorter, being contracted by a burn, or by a wound with loss of substance, or the mucous membrane is enlarged by an inflammation. The whole art of curing these defects in the direction of the eyelids, consists in restoring the equilibrium, by removing a part of the integuments which preponderate. Inflammation may affect the different layers of this region and constitute erysipelas, palpebral ophthalmia, or finally, a phlegmon : this latter, at the large angle is termed anchylops. The laxity of the subcutaneous tissue explains the frequency of its puffiness, even in females who are menstruating. Cancer of the eye sometimes in its progress attacks the eyelids : cysts are often developed, sometimes they are superficial and sometimes deep : some of them should be treated externally, others internally ; these tumors are often bounded by a reddish cellular membrane which is fungous internally ; they then contain a purulent matter. The prolapsus of the upper eyelid is always complicated with the traction of the eye externally, which depends on an anatomical arrangement to be mentioned when speaking of the internal orbitar region. An inflammatory tumor sometimes appears between the eyelashes ; it is situated in one of the ciliary follicles ; the direction of the lashes is sometimes bad from their abnormal insertion, *trichiasis ;* if they are turned inward, the only way of remedying this, is to pull them out and afterwards destroy their bulb with the actual cautery. Jaeger, in this case, has proposed to cut off the loose edge of the eyelid, and Beclard has incised it from its loose edge to its base ; but these operations are not admissible. Finally, the eyelids may sometimes adhere posteriorly to the globe of the eye, and a slight operation is required to separate them. The puncta lachrimalia may be obstructed or obliterated ; in the latter case, A. Munro proposes to restore them, and A. Petit advises to make an artificial passage for the tears behind the

eyelids. For the first, we try to introduce an instrument, and these ducts are injected. By raising the upper eyelid, we remove the only curve of the superior lachrymal passage ; the inferior passage cannot be straightened, because it has two curves ; these are the only reasons why, in operating for fistula lachrymalis, according to the mode of Anel and Mejean, we use the superior passage for introducing an instrument into the lachrymal ducts. The want of a point of support on the cheek, a reason which is not founded on anatomy, causes the lower passage to be selected for injections. Morgagni and J. L. Petit assert that the lachrymal passages may give rise, by their successive dilatation and ulceration, to a lachrymal tumor and fistula ; but the lachrymal sac is connected most directly with these two symptoms of the same disease, the *obstruction of the nasal canal :* sometimes it is impossible to re-establish its permeability, sometimes, and more frequently, circumstances favor this. In the former case, to obtain a cure, we must make an artificial passage by piercing the unguiform bone : in the second case, the passage must be cleared, by the methods of Anel, Mejean, Laforest, and particularly by a modification of that of Petit. In the early stages, the lachrymal tumor seems strangulated in the centre, which depends on its relation anteriorly with the tendon of the orbicularis palpebrarum, which resists the distention : lachrymal fistulæ appear below this tendon, because this sloping part of the lachrymal sac is that which is dilated and afterward ulcerated. The relation of the tendon of the orbicularis muscle is also used by surgeons in operating for fistula lachrymalis ; it serves as a guide in dividing the sac, whether according to Munro's operation it is divided, or is avoided by cutting below it, as is more generally done.

6. INTERNAL ORBITAR OR OCULAR REGION.

The limits of this region are fixed by its skeleton, which belongs also at the upper part to the region of the base of the skull, below and inward to the olfactory cavity and to the maxillary sinus, on the outside, to the temple, and also to the base of the skull.

Its dimensions and its direction depend on those of the orbitar cavity ; the first vary a little ; but this is not true of the second, the axis of which looks forward and a little outward.

The only anterior face of this region is loose and must be examined first ; it is alternately concealed or exposed by opening or shutting the eyelids ; in the centre, which is formed by the globe of the eye, we distinguish ; the anterior part of the sclerotica, (the white of the eye,) its union with the transparent cornea, and finally, the cornea, which is situated directly in the centre ; from the transparency of the cornea

we can distinguish more deeply, the iris and the opening of the pupil which appears black, because the dark base of the eye is seen, in front of which only transparent media are situated ; on the outside of the eye, the anterior face of the orbitar region, in its unattached portion, presents the sinus formed by the reflection of the conjunctiva, in which some physiologists assert that the tears flow during sleep ; on the inside, we see a prominence, which is formed by a mass of follicles secreting a gluey matter ; this is the *caruncula lachrymalis*, on which the conjunctiva forms a fold termed the *membrana nictitans*, the third eyelid in certain nocturnal animals.

Structure.—1. *Elements.* The skeleton of this region forms its boundary as has already been remarked, and is composed of the frontal and sphenoid bone above ; the superior maxillary, the palatine, and the malar bones below ; the ethmoid, the unguiform, and also the sphenoid bone on the inside ; finally, of a portion of the malar bone and of the temporal wing of the sphenoid bone, on the outside ; these bones, which form the parietes of the orbit, are united by sutures ; of these walls the external alone is oblique inward and backward, the others are horizontal or directly antero-posterior ; we have already mentioned the union they establish with other regions ; they are very thin and their resistance is slight ; in this latter respect, the internal is distinguished from all others ; next comes the superior, then the inferior and the external ; their periosteum is continuous with the dura-mater, the external wall unites with the upper and inferior, and forms two fissures, one superior, the other inferior, both of them external ; we shall call the first the *cranial*, the other the *zygomatic*, according to their relations. The globe of the eye occupies the centre of the cavity, and is formed by numerous elements, the description of which does not belong to our work, but all of which will be mentioned when speaking of the relations ; we will only say that in some of them the rays of light are refracted, while in others they are absorbed ; one alone forms a sensitive layer for receiving impressions, and others are protecting parts ; finally, we find in it vessels of all kinds and nerves, but no cellular tissue nor fat. The orbit contains seven muscles ; six of them are motors of the globe of the eye, one alone belongs to the upper lid :* among the first, four of them are straight and two of them are oblique. A considerable mass of cellular and adipose tissue forms an elastic cushion behind the eye, on which the latter moves ; this cellulo-fatty mass communicates through the upper and lower orbitar fissures with the cellular tissue of the skull and that of the zygomatic

* Authors assert, but wrongly, that the levator palpebræ superioris muscle terminates anteriorly in a thin aponeurosis ; we, however, have proved the contrary. Its fibres only separate, and become paler, which circumstance has doubtless contributed to the error mentioned.

region. The orbitar arteries come from the ophthalmic, which is given off by the carotid cerebral artery; which arrangement from the circulation of this region must be considered as an appendage of the circulation of the brain ; the trunk of the ophthalmic artery, as has been seen, anastomoses with those of the face and temple. The veins go to the skull in a common trunk and open into the cavernous sinus: the ophthalmic vein also may be compared in respect to its arrangement with the great emissary veins. The lymphatic vessels are but little understood; some appear to go toward the base of the cavity; others descend through the lower orbitar fissure. The second, third, fourth, and sixth pairs of nerves are appropriated entirely to this region, where we find also the upper branch of the fifth pair, which only passes through it and gives off no special ramifications; we also find there the ophthalmic ganglion, the anterior angles of which give off the ciliary nerves, while the posterior angles communicate each by a filament with the common motor nerve and with the nasal branch of the ophthalmic nerve of Willis.

2. *Relations.* The relations of this region are difficult, and hence they must be laid down very strictly. The globe of the eye and the optic nerve form an axis, around which the other organs are placed: but we must first attend to the special arrangement of the eye itself.

1. If we pierce it with a needle in the direction of its axis, we perforate successively; the conjunctiva, which passes on the cornea; the different layers of the cornea, which are separated by a transparent fluid; the anterior fold of the membrane of the aqueous humor; we then come into the anterior chamber of the eye, a space formed by a concave anterior wall and a posterior wall which is perfectly plane; after passing through this chamber, which is filled with the aqueous humor, the needle penetrates into the posterior chamber freely in the centre, through the opening of the pupil, which is surrounded by a very remarkably small arterial circle; on the outside of the pupil, it wounds the iris and the three layers which compose it, the first belonging to the membrane of the aqueous humor, the second formed by the special tissue of the iris, the latter, the *uveal* membrane, the internal layer of the choroid membrane. This posterior chamber is smaller than the anterior, and is also filled with the aqueous humor in the adult: it is closed anteriorly by a plane wall, and posteriorly by a convex wall, while the circumference is formed by the ciliary processes, *folds of the internal coat of the choroid membrane.* After passing through this space, the instrument arrives more deeply at the hyaloid and the crystaline capsules;* the humor Morgagni, which

* The crystaline lens has, in fact, two envelopes or capsules; its proper capsule, and one from the vitreous body.

separates this latter from the tissue of the crystaline lens, escapes, the lens is perforated, and the needle comes into the vitreous body, where it may wound the central artery which passes through the hyaloid canal discovered by Jules Cloquet: finally, beyond this space in which the vitreous body is situated, we fall successively on the retina, the choroid membrane, and the sclerotica; it must be directed a little inward, to arrive at the insertion of the optic nerve.

2. If we pierce the eye from without inward, at the union of the cornea with the sclerotica, the needle would wound successively the conjunctiva, the union of the two preceding membranes, the ciliary circle, which adheres to them intimately on the inside, the great circumference of the iris, and its great arterial circle: if we then incline its point a little backward, it would wound the ciliary processes, and would penetrate into the posterior chamber; if we then incline it forward, it would come, on the contrary, into the anterior chamber, after passing through the membrane of the aqueous humor. Finally, two lines or more from the union of the cornea with the sclerotica, the needle will pass through, in order to arrive at the crystaline lens anteriorly, and the hyaloid capsule posteriorly, the sclerotica, the choroid membrane, and the retina; between the first two some vessels and nerves of the iris will sometimes be wounded, and sometimes the instrument will glide between these filaments, which proceed from behind forward.

On the outside of the eye and the optic nerve, central parts of the internal orbitar region, the relations must be examined *superiorly*, *inferiorly*, *externally*, *internally*, and *anteriorly*. 1. *Superiorly.*—The bone with its periosteum being removed, we find the supra-orbitar vessels and nerves extending along the orbit, and posteriorly, only the pathetic nerve directed inward; more deeply, the levator palpebræ superioris muscle; next, the rectus oculi superior muscle; below, the vessels of the superior muscle and the ascending branch of the common motor nerve; finally, in the centre of the fat, directly on the optic nerve, the nasal nerve and the ophthalmic artery, which go from without inward, then the ciliary vessels and nerves, which are parallel with the optic nerve. 2. *Inferiorly.*—The bone being removed and also the infra-orbitar vessels and nerves which are there situated first in a groove and then in a canal, we discover successively; the rectus inferior and the obliquus minor muscles, the lower branch of the common motor nerve, and the filament which it sends to the ophthalmic ganglion, and finally, the inferior muscular vessels which are situated in the midst of the fat. 3. *Internally.*—On removing the olfactory wall, and looking toward the optic nerve and the eye, we perceive first a plane formed by the obliquus superior muscle above,

and the rectus internus below, and between them by the nasal nerve and the ethmoidal arteries; more deeply, in the centre of the fat come, first, posteriorly, the end of the pathetic nerve and also the nasal nerve, which is soon situated in the preceding plane; second, anteriorly, the ophthalmic artery and vein. 4. *Externally.*—Below the bones, through which pass some nervous and vascular filaments which serve to anastomose with the temple, we find the lachrymal nerves and vessels, and the lachrymal gland superiorly; below, the rectus externus muscle, which bifurcates posteriorly, and thus gives passage to the common motor, the external motor, and the nasal nerves; finally, between this muscle and the eye, some adipose tissue, in which the nasal nerve, the ophthalmic artery and ganglion are situated, posteriorly. 5. *Anteriorly.*—After removing the eyelids, the anterior plane is perfectly exposed; it is formed around the eye by much cellular and adipose tissue, in which we distinguish, first, above, emerging from this region, the supra-orbitar vessels and nerves which curve upward, the levator palpebræ superioris muscle, the anterior extremity of the lachrymal gland, the reflected tendon of the obliquus superior muscle, and the extremity of the ophthalmic artery; second, below, the obliquus inferior muscle, which turns the eye upward and outward.

Development. The internal orbitar region is developed before the external; it is very prominent in the early periods of life, and is distinguished by a black point, the rudiment of the globe of the eye; the osseous frame forms at a later period. The description of the different forms assumed successively by the eye, belongs to descriptive anatomy; but their importance, and also their omission in many elementary treatises, determines us to mention them here. The eye is formed at first of parts which are perfectly transparent, not excepting the sclerotica; it is spherical, but afterwards becomes flattened; the cornea is very prominent, and the whole anterior chamber is dilated by the continuance of the aqueous humor in this point, according to J. Cloquet; during the first months of fetal existence, this chamber does not communicate with the posterior; the continuity is established afterwards, by the rupture of the membrane which closes the pupil, which membrane Cloquet has discovered to be formed by two layers, one of which belongs to the membrane of the aqueous humor; the plexuses of the arteries of the iris extend between these two layers of the pupillary membrane, which arteries anastomose from their sides, and not from their convexity. At the seventh month, the pupillary membrane breaks, and the pupil is formed. As, according to Cloquet, this rupture is caused by the retraction of the arterial plexuses, or by the absorption of the centre of the membrane, the small and arterial circle of the iris is then formed regularly. The posterior

chamber, the parietes of which were previously contiguous, dilates by the presence of the aqueous humor.* The crystaline lens is at first very soft, and formed of three segments, separated by three linear spaces, which contain a fluid analogous to the humor of Morgagni. The centre of this organ, however, is formed before its circumference. The vitreous body is very much developed before birth.

Varieties. The ophthalmic artery frequently passes below the optic nerve; sometimes it is divided into two branches, which embrace the nerve, and afterwards reunite; one of these two roots often represents the common origin of the artery, the other comes from the middle meningeal artery, and passes through the sphenoid fissure; sometimes the middle meningeal artery gives off only the lachrymal artery. Although the eye is very prominent in the normal state, it is sometimes situated very deeply, which may depend on two causes: first, the greater or less depression of the bony arch of the cavity; second, the variable development of the cushion of fat at the posterior part of the eye. In albinoes, the bottom of the eye and also the pupil appear red, which depends on the absence of the black pigment of the choroid coat.

Pathological and operative deductions. The whole, or a part of the pupillary membrane, may continue after birth. These varieties are explained by anastomoses, formed abnormally between the convexity of opposite or simply contiguous arterial plexuses of the pupillary membrane; in the former case the rupture cannot occur; in the second case it occurs, but leaves through life a floating fold of the membrane. Beclard, in his lectures, mentioned a striking instance of this latter arrangement.

Wounds of this region, if they affect the globe of the eye, may destroy it immediately or by consecutive inflammation; they may also be followed with specks, or opacity of the transparent media: when exterior to the globe of the eye, they are not very serious, except where the piercing instrument penetrating deeply, they are complicated with an injury of the orbitar arch, of the internal and external bony parietes, or of the organs situated in the sphenoid fissure and zygomatic fossa. Farther, in extirpating the eye, we must guard against plunging the instrument too deeply, in order to avoid these complications: the lachrymal gland, ought also to be removed in this operation, because the continual secretion of the tears would be injurious. Sometimes we may amputate the globe of the eye instead of extirpating it; we must then be careful to cut it beyond the iris, lest this membrane should contract

* This is Jules Cloquet's opinion: we must, however, observe, that Edwards thinks, before the rupture of the pupillary membrane, the aqueous humor, on the contrary, occupies the posterior chamber, or, according to him, is formed by the ciliary processes.

in its centre, and prevent the evacuation of the vitreous humor, and consequently the formation of a stump for the insertion of an artificial eye. We have observed a case of this kind at the Hospital la Charité; Boyer was obliged to operate a second time. The eye may be carried forward, and may project between the eyelids; this is *exophthalmia*, a symptom of many deep diseases of the orbit, such as inflammation, osseous, erectile or fungous tumors of the dura mater. Inflammation of the orbit is very severe, and may be fatal; it easily extends to the zygomatic region, through the inferior orbitar fissure, and particularly through the superior into the cranium, around the cavernous sinus, or even into this, when there is at the same time, as we have seen twice, an inflammation of the ophthalmic vein. Travers has cured an erectile tumor, which had caused exophthalmia, by tying the primitive carotid artery. A polypus, developed in the maxillary sinus, may produce exophthalmia, by raising the superior wall of this sinus. The connexion of the vessels of this region, with those of the brain, explains the redness of the eye, and the pains of the orbit, in cerebral affections. In ophthalmia, the conjunctiva of the eye is most commonly diseased, that which passes on the cornea is often affected at the same time; this last is injected and slightly swelled, on account of its intimate adhesion; the sac which rises above the cornea, in *chemosis*, forms at the place where this union suddenly becomes very loose. Sometimes the cornea alone is inflamed, softens and ulcerates, or is relaxed and dilates in the form of a sac, *staphylona*. The spots which appear on this membrane, are situated sometimes on the conjunctiva, *nebulæ;* sometimes they result from the opacity of the interlaminar fluid, *albugo;* or, finally, they are cicatrices, *leucoma*. The diseases of the aqueous humor, of the iris, of the crystaline lens, and of the vitreous humor, are marked by modifications in the properties of these parts, which can be perceived by examining the eye, Of these diseases, cataract is the most frequent: it is caused by the opacity of the crystaline membrane, of that of the crystaline lens, of the humor of Morgagni, or simply of the crystaline tissue, in the points where the three segments which form it in early life unite: these cataracts are the *membranous*, the *crystaline*, the *milky*, and the *diffuse*. Old men are subject to a varicose state of the choroid veins, in consequence of which, the pigment of the choroid membrane disappears in the points corresponding to the varices, and the vision is very much impaired. In extracting a cataract, we must remember that the cornea is very thick, and hence the instrument should act upon it perpendicularly, in order to cut it evenly; we must avoid the small circle of the iris with the instrument, which should not be introduced very far forward, lest the vitreous body be opened, and its humor be partially evacuated. This accident, however, is not always

fatal. In depressing the cataract, the sclerotica is wounded, two lines from its union with the cornea, to avoid the retina posteriorly, the ciliary circle and the iris anteriorly; we always wound the conjunctiva and the sclerotica, the choroid membrane, the ciliary processes, the vitreous body, and the crystaline lens; the needle is carried below the external extremity of the transverse diameter of the eye, to avoid the long ciliary artery, which is situated in this part; finally, the convexity of the needle is turned upward, because, in this position, it presents its greatest diameter longitudinally, and thus the ciliary vessels and nerves, which go from behind forward, are less liable to be wounded. In operating for artificial pupil, the great arterial circle of the iris may be wounded; this accident is peculiar to it. After operating deeply upon the eye, it inflames; its internal parts swell, and if they are not freely divided, the extreme resistance of the envelopes may produce strangulation; hence severe and deep seated pains, and loss of vision; if the cornea, on the contrary, is divided, the aqueous humor escapes; hence the inflammation is arrested, and it is never strangulated, and the internal parts may swell as much as this change requires. From these facts extraction seems to us preferable to depression, in operating for cataract; the most celebrated practitioners, however, are still divided in their opinions on this subject.

PARAGRAPH FOURTH.

ZYGOMATIC FOSSA.

This region is situated deeply below the temple, between the cranium and the face above the masseteric portion of the malar region, on the inside of the parotid region, and on the outside of the orbit and the nasal fossæ, with which it is connected by the nerves and vessels.

It is difficult to determine its form; it is composed of two portions, one of which is more superficial, the *zygomatic fossa*, the other is more deep, the *spheno-maxillary fossa*: both are united by the *pteryo-maxillary fissure*.

Structure.—1. *Elements.* This small region is bounded by its skeleton; it is specially formed by the sphenoid bone, the posterior part of the superior maxillary, the palatine, the condyle of the lower maxillary, a part of the temporal and the ethmoid bone at the base. It marks the two portions of the region which have been indicated; they communicate with the orbit, the first by the inferior orbitar fissure;* the second, near the point where this last fissure unites with

* In animals this fissure enlarges, the orbit and this region are less distinct; in fact, in some animals these parts are entirely blended.

the superior; in the summit of the zygomatic fossa are five foramina; only one of these deserves our attention, the *spheno-palatine;* it is broader than the others, and in a prepared head, it establishes a communication between the spheno-maxillary fossa and the corresponding nasal fossa. The condyle of the jaw and the anterior part of its temporal articulation* correspond also to the zygomatic fossa. This articulation is protected on the inside by the spine of the sphenoid bone and the internal lateral ligament which arises from it; on the outside, by a tubercle of the zygomatic process, and the external lateral ligament; posteriorly, by the auricular passage, while anteriorly, it is very loose; it encloses a layer of fibrous cartilage which is often perforated in the centre, and finally, it is lubricated by one or two synovial membranes, according as the foramen of the inter-articular layer does or does not exist. The pterygoideus internus muscle is situated entirely in this region and is confined to its lower extremity. It is formed by two fasciculi, between which is a narrow triangular space. The lower extremity of the temporalis muscle is situated in the zygomatic fossa. The internal maxillary artery passes through it and terminates in its summit; it gives off in that part a considerable number of branches, among which are thirteen principal twigs, which have received special names; it is accompanied by a vein which anastomoses superficially with the facial vein as has been mentioned. The lymphatic vessels are little known, they go to the parotid and the deep cervical ganglions; the nerves are numerous, and for the most part only pass through this fossa; among them may be mentioned the superior maxillary nerve and its inferior orbitar and dental filaments, the ganglion of Meckel, the inferior maxillary nerve, which is divided into two branches, a superior and an inferior; these branches are subdivided into twigs, which are; the former, the two deep temporal twigs, the buccal and the masseteric; the second, the lingual, the dental, and the superficial temporal. The adipose and cellular tissues are very abundant at the upper part; they are continuous in this direction with the cellular tissue, which fills the base of the orbit.

2. *Relations.* When the zygomatic arch and the lower extremity of the temporalis muscle which forms the first layer are removed, we see the external face of the pterygoideus externus muscle, upon which rest the deep temporal vessels, and the masseteric nerve; the two temporal nerves appear in this layer, only when they emerge between the bone and the pterygoideus muscle; if we divide this muscle, we penetrate into the space between its two fasciculi, where the buccal

* The other parts of the temporo-maxillary articulation belong to the parotid and malar regions; it is situated on their limits.

vessels and nerve and a portion of the internal maxillary artery are situated; the second fasciculus of the pterygoideus muscle is found more deeply, in front of which the third portion of the internal maxillary artery ascends perpendicularly, behind the molar tuberosity; while below pass the lingual nerve on the inside, the inferior dental in the middle, and the superficial temporal posteriorly, all united by anastomosing filaments. This is the arrangement of the parts which occupy the first portion of the zygomatic fossa: in the second, the *spheno-maxillary fossa,* we find from above downward; first, the ophthalmic vein and the ophthalmic nerve of Willis, the common motor, the pathetic and the external motor nerves, two filaments of the superior cervical ganglion, parts which come from the sphenoid fissure, and pass through the spheno-maxillary fossa, to go into the orbit; second, the superior maxillary nerve, which proceeds from behind forward; third, the ganglion of Meckel which is continuous with the preceding nerve, is situated on the outside of the spheno-palatine foramen, and sends off downward the palatine filaments, anteriorly the posterior dental, posteriorly the vidian twig, a ganglion surrounded by fat, and the four terminating branches of the internal maxillary artery, the vidian, the pterygo-palatine, the superior palatine, and the spheno-palatine arteries.

Development. The zygomatic fossa is very narrow in the young child; but then its communications with the orbit are very broad; in the adult it dilates, and at the same time the orbito-zygomatic fissures contract; in the old man, these are dilated much more, on account of the thinness and absorption of the osseous substance which forms their circumference, and in this respect only the infantile state reappears.

Varieties. The internal maxillary artery, instead of passing between the two portions of the pterygoideus externus muscle, often glides on the outside of it.

Pathological and operative deductions. Wounds of this region are very severe: first, because they necessarily suppose that the piercing instrument, before arriving there, passes through the cheek, the temple, the parotid region, or the orbit; second, because it is almost impossible for the branches of the internal maxillary artery or its trunk to escape. This was the case with a soldier, in whom Marjolin, in 1814, tied the primitive carotid artery, which afforded the only chance of arresting the hemorrhage: this mode, however, is uncertain, on account of the anastomosis of the arteries, as this skilful professor experienced. This region, situated between the cheek, the temple, the parotid region, the orbit, the nostrils, and the skull, has often served to establish morbid communications between these points, by the continuity of the vessels and by that of the cellular tissue. We have seen the maxillary sinus

destroyed at its posterior part, by polypi, which appeared in the zygomatic fossa, which then advanced farther, and even to the temporal fossa. We have already cited the remarkable instance of another polypus which had followed the same course, coming from the nasal fossa through the enlarged spheno-palatine foramen: the two following cases, which occurred at the Hospital la Charité, point out still better the morbid communications between the regions mentioned. Two individuals, one after the neck of the condyle of the jaw had been broken, the other after a panaris, were affected with a swelling in the parotid region: soon afterwards, the eye projected, the brain became affected, and they died. On opening their bodies, we discovered an inflammation of the parotid, temporal, and internal maxillary veins, which also extended to the ophthalmic vein and the cavernous sinus.

The temporo-maxillary articulation can only be dislocated anteriorly, on account of its mechanism and its looseness in this direction: the condyle then frees itself from the transverse root of the zygomatic process, and goes a greater or less distance into the zygomatic fossa, being acted upon by the unequal force of the external pterygoideus muscle: dislocation may be produced by the action of the muscle alone. Some forces, unconnected with the zygomatic fossa, that of the masseter and of the pterygoideus internus muscles, may contribute to it, when the jaw is depressed by any cause: the tendency of these last muscles to produce dislocation, when the jaw is elevated, after being forcibly depressed, is admitted by no one; and anatomy rejects it, because the line in which their action extends is anterior to the maxillary condyle.

CHAPTER II.

OF THE COCCYGŒAL EXTREMITY OF THE TRUNK.

The coccygœal extremity of the trunk, the *tail*, is very distinct in most animals from its central portion, and should be specially considered. In man, on the contrary, it is very small, and is so blended with the abdomen, and particularly with its pelvic portion, that it cannot be distinguished at first view, and will be considered when speaking of the trunk.

SECTION II.

CENTRAL PORTION OF THE TRUNK.

The central portion of the trunk contains two great splanchnic cavities, the *thorax* and the *abdomen:* it is united to the head by a circular contraction, the *neck.*

CHAPTER I.

OF THE NECK.

The neck is situated between the chest and the head, and is an appendage of the latter.

Its form is irregularly cylindrical: it is convex anteriorly, and evidently flattened posteriorly. Its direction is a curve slightly convex anteriorly. Its superior and inferior boundaries are very definite anteriorly, the base of the lower jaw on one side, and the sternum and the clavicles on the other: posteriorly, however, its boundaries are slightly marked, as we shall show when speaking of the region of the nucha.

The neck, when considered externally, presents two faces, on which the median raphe is unequally marked: one is anterior, where its traces are extremely slight; the other posterior, where they are very distinct.

Some organs of the neck have a special cavity; but the region itself has none.

Structure. The base of the neck is formed by the cervical portion of the spine: this part communicates to it its peculiar direction, and is distinguished by its transverse flattening, and also by the passages of the root of the transverse processes. The vertebral canal is broader there than in any other part: it has the form of a triangle with rounded

angles: the vertebral layers which form it posteriorly, are separated by great spaces, filled by the yellow ligaments: this arrangement exposes the medulla in this part to external injury. The elements of this skeleton of the neck are seven vertebræ, which are united to each other, while the first is joined to the head in a mode which combines solidity and mobility: to avoid repetition, this part can be here described only in a general manner, as it belongs to almost all the secondary groups of this portion of the trunk. The upper part of the spinal marrow, particularly the brachial enlargement, belongs to the neck: we also find there muscles, which partially or entirely belong to it, some of which may be referred, in respect to their uses, to the air-passages and the digestive apparatus; others to the hyoid bone, the spine, the head, the thorax, and the thoracic members: we also observe the different vessels, some of which belong to the neck, others to the arm and the head; they ascend from the heart towards the head, or follow an opposite direction. Farther, six large arterial trunks pass through the neck, four of which are parallel to its axis, the carotids and the vertebral arteries, and are enclosed in a bony canal; while two appear only for a moment at its base, and then go to the thoracic limbs, the *subclavian trunks*. The principal veins of the neck are four large veins, which are termed the jugular veins: two of them are deep, and two superficial. We also find a great many lymphatic ganglions, the common rendezvous of all vessels of this order which arise from the neck itself, the head, the thoracic limbs, and some parts of the chest: ganglions are rare upon the median line, but are situated more particularly on the side, and form a continuous chain from the ear to the thorax. The nerves are given off towards the thoracic limbs and the thorax: sometimes, but rarely, they reascend from this last point, the recurrent nerves. The cervical nerves, which emanate from the spine, form two plexuses: an upper, the superficial, the branches of which are distributed almost exclusively to the neck; another, which is inferior, and deep, belonging particularly to the thoracic limb. The cellular and adipose tissues are abundant, and the skin which surrounds all these organs presents nothing peculiar.

Development. In the early periods of fetal existence, there is no neck: the young embryo, attached to the umbilical vesicle, is entirely abdomen: at a later period, a circular and narrow contraction indicates its place: it rapidly increases, and is then proportionally longer than in the adult. At puberty, it becomes arched anteriorly, and gradually grows smaller than in infancy. In the old man, it is drawn forward by the weight of the head, which is supported with difficulty by the posterior muscles, and the neck is concave in this direction, as during fetal existence: at this age, also, the motions become more difficult, on

account of the rigidity of the muscles of the spine. A costiform* epiphysis forms at an early period in the fetus, in front of each transverse process: this is longer on the last vertebra: this piece soon fuses with the transverse process, and forms the foramen of the vertebral artery.

Varieties. The cervical portion of the trunk is sometimes considerably long, even in the adult: this is an anomaly, which is often attended with a bad formation of the thorax, and which is therefore considered as the sign of a disposition to phthisis pulmonalis. Sometimes the neck is very short; another anomaly, which, approximating the chest and the heart to the head and the brain, disposes sometimes to cerebral hemorrhage, and forms one of the characters of what is termed an *apoplectic habit.* Sometimes only six cervical vertebræ are found, and never more than seven:† in the former case, there is a supernumerary rib. These two irregular arrangements are easily understood, by supposing that the costiform process of the seventh cervical vertebra is extended in the form of a rib to the sternum. Some assert that this occurs in all those who have an apoplectic habit; but our observations have proved the contrary.

In the female, the neck is more delicate and round than in the male: in the latter, all the prominences and depressions are more distinct.

Finally, in the motions, the extent of the neck varies in different parts: thus, in flexion, it becomes shorter anteriorly, and extends posteriorly: the opposite is true in extension: hence the precept, in operations on the neck, to cause the patient to assume such a position, that the part operated upon must be opposed to the motion in which the whole region inclines.

Pathological and operative deductions. The arrests of development, supervening at periods more or less near that of conception, explain the different deviations in the formation of the neck; these are its entire absence, (*abrachio-cephalia*, Beclard,) a monstrosity, the name of which merely shows the simultaneous absence of the head and the thoracic extremities, the last not being formed, perhaps because the brachial bulb of the medulla did not previously exist: the absence of the upper half of the neck only, (*atrachelo-cephalia*, Beclard.) In these latter cases, the brachial enlargement of the medulla exists with the corresponding limbs.

In old people, and young children, caries often affects the cervical portion of the spine, and the pus formed by it assumes different situations, according as the disease affects the anterior or posterior parts of

* This epiphysis may be considered as analogous to the cervical ribs of some animals, particularly of crocodiles.

† Only one mammal has more than seven cervical vertebræ, the bradypus tridactylus, which has nine.

the spine. If the medulla be wounded or compressed in the neck, by any cause, death instantly follows, respiration ceasing. This is the reason that the fractures and dislocations of the cervical vertebræ, and certain wounds, are so serious. Dislocations of the first two vertebræ are more common in infancy : at this age, they are sometimes produced by a fall on the head, because the odontoid process being shorter, projects but slightly above the transverse ligament, behind which it passes easily. A shock upon the spinal marrow, in certain motions of the head upward, may alone cause death, as was seen by J. L. Petite once. The fear of injuring the medulla, or of rendering complete imperfect dislocations of the cervical vertebræ, should always prevent us from attempting their reduction.

Such are the general remarks upon this important portion of the trunk : it is composed of two groups, which are separated by the spine ; an anterior, (*trachelien*, Ch.) and a posterior, (*cervical*, Ch.)

ARTICLE I.

TRACHEAL PORTION OF THE NECK.

Chaussier applies this term to the anterior part of the neck, because it contains the trachea : it may also be called the *pharyngeal* portion.

We remark, externally, above the sternum, a considerable median depression, above which is the *laryngo-tracheal* prominence, which are included between the sterno-mastoid muscles : on the sides, in front of these two prominences, which are extended from below upward, and from before backward, is a depression, in which we can feel the pulsations of the carotid artery : while backward and downward, they bound another depression, termed the supra-clavicular, in which the pulsations of the axillary artery can be felt.

Structure.—1. *Elements.* All this part of the neck rests on the anterior face of the spine : a portion of the air-passage, and of the digestive tube, belong to it, with all the cervical lymphatic ganglions : it is also exclusively the seat of the cervical aponeurosis, although some persons confound it with the dense cellular tissue which exists posteriorly, and which has no lamellar arrangement.

This aponeurosis, the *fascia cervicalis*, (Burns,) should be described

when treating generally of the tracheal portion of the neck, because it extends to every point of this portion, and our idea of it would be imperfect, if we divided its study among that of the different regions. Finally, it should be described more minutely, because this part, although extremely important, is generally unnoticed in treatises on anatomy.

Although the fascia cervicalis covers the whole tracheal face of the neck, it is most apparent at the lower part; here also it is denser, and its arrangement is more complex; it extends from above downward, from the base of the jaw to the sternum, and to the clavicle; its lateral boundaries are less exact, and vary in different parts, as we shall see; this aponeurosis extends superficially to the skin; deeply, it rests on the hyoid muscles and the trachea; it adheres very intimately to the hyoid bone, and the larynx; at these parts it is simple, but, in every other part, above or below, it is formed of at least two layers, a superficial and a deep. The first is triangular, unites with the other in the place mentioned, and connects the two platysma muscles from above downward; it commences above in a point on the jaw; below, it glides before the sterno-mastoid muscles and the sternum, and soon terminates in the subcutaneous tissue of the thorax. The second passes on the upper part below the platysma muscles, on the outside of the digastrici muscles, and of the sub-maxillary gland, and terminates at the lower edge of the jaw, and also at its angle, being continuous with the stylo-maxillary ligament: inferiorly, this second layer of the cervical aponeurosis is situated below the sterno-mastoid muscles, and in front of the sterno-hyoid and thyroid muscles, then comes downward and terminates on the summit of the sternum, and on the posterior edge of the clavicle: it is attached laterally to the central tendon of the scapulo-hyoid muscle, and keeps it in its position; we must not blend this layer with the dense tissue which covers the carotid artery, and forms its sheath. This deep layer of the cervical aponeurosis is separated from the trachea and the thyroid gland, by the sterno-hyoid and thyroid muscles; but, on the outside of these, it gives off downward a secondary layer, which extends between these muscles and the trachea; this layer adheres above very intimately to the lower edge of the thyroid body, and is continuous below with the periosteum, which covers the posterior face of the sternum.

The cervical aponeurosis is, in fact, composed superiorly of two layers, and inferiorly of three; in consequence of this latter arrangement, it forms, with its superficial and middle layers, a special sheath for the lower part of the sterno-mastoid muscles, while the last and third layer, which is very dense, envelopes the small infra-hyoid muscles.

The tracheal position of the neck, as we have remarked, is occupied above by the *pharynx*, a kind of expansion of the digestive tube, the special description of which, does not belong to our subject, but the topography must be stated here, because it corresponds to several of the regions which we shall soon examine in detail. This complex organ, or this *pharyngeal* region, has no special wall anteriorly; in this direction, it is formed successively from above downward, by the palatine, the glosso-supra-hyoid, and the laryngo-tracheal regions; it is open in three points, to communicate with the nostrils, the mouth, and the larynx. Posteriorly, and on the sides, however, the pharynx has proper parietes, which are formed from without inward, by a layer of muscular fibres, a dense cellular tissue, and a very follicular mucous membrane.

The pharyngeal region is bounded posteriorly by the longus colli and the anterior rectus capitis muscles, from which it is separated by a lamellar and very loose cellular tissue; by means of these parts it corresponds to the anterior face of the spine, at the first five cervical vertebræ, and also to the rectus capitis anticus minor, which is situated under the rectus major. Forward and on the outside the pharynx is connected with several cervical regions, as we shall state hereafter. Above, it is united by the cephalo-pharyngeal aponeurosis, to the lower face of the basilar portion of the base of the skull. Besides its communication with the cavities of the nostrils, the mouth, and the larynx, the cavity of the pharynx is continuous inferiorly with the esophagus; the Eustachian tubes also come to it in the parts mentioned. The velum palati, when it is elevated horizontally, divides the cavity of the pharynx into two portions, a superior, the *gutturo-olfactory*, and an inferior, the *bucco-laryngæal:* and then, also, we can observe in the mouth the loose face of the posterior wall of the pharynx, its rosy color, and the follicular granulations which cover it: these will be seen more clearly by depressing the base of the tongue at the same time. The dimensions of the cavity of the pharynx are highly important; its height is four inches and three lines; its antero-posterior diameter diminishes progressively from above downward, in the state of rest; and also varies continually, during the contraction of the pharyngeal muscles; the mean measure of this diameter, at the base of the tongue, is one inch and five lines; the transverse diameter does not decrease in the same proportion as the preceding; farther, it is always the same in two points; first, at the opening of the nasal fossæ; second, between the horns of the hyoid and thyroid cartilages; in the former point, it measures an inch and a half, and one inch and nine lines in the latter.

Uses. The pharynx forms a kind of vestibule, common to the air-

passages and digestive apparatus; sometimes, as in deglutition, its uses relate exclusively to the latter; sometimes, as in respiration, to the former. During articulation, the velum palati rises, and prevents all communication between the upper and lower portions of the pharynx: the air cannot then enter into the nasal fossæ; when the air passes into these parts, the tone is nasal.* The cervical aponeurosis being extended on this portion of the neck, renders it very resisting, and prevents the trachea, in deep inspirations, from being compressed by the external air, which tends to form an equilibrium with the internal rarefied air. The depression above the sternum, which is so distinct in difficult respiration, is explained by this theory.

Pathological and operative deductions. Wounds of the neck may be complicated with penetrating wounds of the trachea and digestive passages; hence result fistulæ of different characters: hence, also, infiltrations of air which constitute emphysema. The uses of the cervical aponeurosis in respiration, explain the difficulty of respiration in individuals, in whom it has been affected by wounds, or by the progress of an abscess. The tumors which are developed on the outside of this fascia go towards the skin; those, on the contrary, which are situated under it, penetrate deeply toward the air-passages and digestive apparatus, impede respiration and deglutition, and, *a priori*, it is impossible to judge of their size; finally, those which appear between its lower layers, present mixed characters.

The anterior abscesses of the neck generally proceed like other tumors in this great region, their progress is modified by their position relative to the aponeurosis: those which are situated deeply, have a peculiar tendency to point in the chest, which termination is facilitated by the laxity of the anterior cellular tissue.

The almost immediate relations of the spine and pharynx, explain the opening into the throat of some abscesses, resulting from the caries of the vertebræ, and reciprocally the affection of the latter consequent upon diseases of the pharynx. We have seen a purulent tumor developed between the pharynx and the spine, which impeded deglutition, until it pointed in the former. Farther, all these diseases, with swelling of the regions which surround the pharynx, may contract it,

* This explanation of the quality of the voice, given by Magendie, is contrary to the generally received opinion of Haller; but, we think it preferable. It is also confirmed by the following experiment: place yourself before a candle, a sheet of paper being interposed between the nose and mouth, prevent the air from the mouth from agitating it, and observe what takes place: when the sounds formed are of the usual quality, the flame is motionless, but is constantly agitated if you attempt to speak through the nose. The experiment succeeds still better, if you place under the nose a very volatile powder, it is raised only in the second case; we must be careful not to mistake the agitation of the light, or of the powder during inspirations, if these experiments are continued for any time.

and thus render the deglutition and respiration difficult. Polypi of the nasal fossæ sometimes proceed towards this region, crowd back the velum palati, and prevent it from perfectly closing the posterior cavity of the nostrils; hence a nasal tone, and even a difficulty in deglutition. The division of the velum palati causes the same phenomena, because it is thus rendered unfit for its normal functions, in regard to the larynx. Instruments are introduced into the pharynx to remove foreign bodies, or to sound the pharynx and the esophagus. We shall mention the catheterism of the first again: to perform the second with ease, we must glide the instrument against the posterior wall of the cavity.

Division. The tracheal portion of the neck comprises so many organs, the functions of these are so intimately connected with the support of life, and this part of the body is so important in respect to surgical operations, that it cannot be studied too minutely: hence, we must examine it successively, in detached spaces, which do not always have natural bounds: this latter condition, however, is impossible in some points. After reflecting maturely on this subject, we have concluded that the difficulty may be avoided in two ways, which are not equally good: First, by including all the regions of the neck within arbitrary limits; second, by forming artificial regions only where they can be traced in no other manner; then, in following this latter principle, to group the relations of the adjacent parts around an important organ, which shall give its name to the region. This last mode seems preferable, and it was that chosen by Beclard, for his divisions of the neck, when lecturing on topographical anatomy. Some of the regions thus formed will be entirely natural, and others slightly artificial. The following table, formed on these principles, will give an idea of our division of the tracheal portion of the neck: the practical importance of this division will not be questioned.

TRACHEAL PORTION OF THE NECK.	Natural regions......	Above the hyoid bone.	In the centre...	Glosso-supra-hyoid region.
			On the sides...	Parotid region.
		Below the hyoid bone.	In the centre...	Laryngo-tracheal region.
			On the sides...	Supra-clavicular region.
	Artificial regions..... Groups formed around.	The Sterno-mastoid muscle..		Sterno-mastoid region.
		The Carotid artery........		Carotid region.

PARAGRAPH FIRST.

NATURAL REGIONS OF THE ANTERIOR PART OF THE NECK.

These regions are four: some are unmated and symmetrical, and are situated on the median line; others are mated, are unsymmetrical, and are placed on the sides: the hyoid bone separates them into two groups, an upper and a lower.

ORDER FIRST.

NATURAL REGIONS OF THE SUPRA-HYOID PART OF THE NECK.

These regions connect anteriorly the neck and the head: they are two in number: the supra-hyoid, and the parotid.

1. SUPRA-HYOID, OR GLOSSO-SUPRA-HYOID REGION.

This region is circumscribed above, by the inferior edge of the maxillary bone; below, by the hyoid bone; and laterally, by a fictitious line, drawn between the angle of the jaw and the extremity of the great horn of the hyoid bone: it is unmated, symmetrical, situated on the median line, and forms, if we include the tongue, the floor of the mouth and a part of the anterior wall of the pharynx: for this double purpose it is also directed, so that its horizontal anterior portion forms with the posterior vertical part a rounded and obtuse angle: it is terminated by two faces: one of these is cutaneous, and covered with very coarse hair in the adult male, and presents in fat individuals one or more transverse prominences, which give the appearance of a double chin; the other is mucous, pharyngœal at its posterior part, and presents in this direction, the glandular base of the tongue, the frenum of the epiglottis, and two lateral mucous depressions: it is buccal anteriorly, and also presents nearly the whole tongue, except at the anterior part, where the tongue is detached, and leaves a crescent-formed space, which is convex anteriorly. We find there, on the median line, the frenum of the tongue; near it, two small prominences, in which the duct of Wharton opens on each side; and finally, from this point, a line, which is directed obliquely backward and outward: this marks the passage of Wharton.

Structure.—1. *Elements.* The supra-hyoid region has no skeleton: it is circumscribed by the prominences of the inferior maxillary and hyoid bones; but they do not belong to it: we find there, also, many muscles, the platysmata converging toward each other, and often united above, by a transverse fasciculus; the anterior belly of the digastrici muscles, the mylo-hyoidei, which unite and form a complete and contractile floor, the genio-hyoidei and genio-glossi, the hyo-glossi, the lingualis, a portion of the stylo-glossus, and the special fleshy fibres of the tongue.* A very strong aponeurosis belongs particularly to this region: it is triangular, and is inserted on the hyoid bone and the two tendons of the digastrici muscles, and is continuous with their pulley. A layer of the cervical aponeurosis unites the two platysma muscles upon the median line: we also find, under these latter, a dense cellulo-fibrous layer, the superior deep layer of the preceding aponeurosis. This latter passes below the sub-maxillary gland and its vessels, is attached to the lower edge and to the angle of the jaw, continuing with the stylo-maxillary ligament, so as to form a much more distinct line of demarcation between the parotid and sub-maxillary glands than is generally admitted. The arteries of this section of the neck are very numerous: a considerable tortuous branch passes through it, following the course of a line drawn from the hyoid bone toward the anterior edge of the masseter muscle: this artery is the facial, which sends off in its course several important branches into the elements of this region: one of these forms the sub-mental artery, another the inferior palatine artery,

* We have ascertained that the tongue is not an inextricable mass, according to the expression of anatomists, and that it is formed: first, of a median cartilage, analogous to the lingual prolongation of the hyoid bone of birds, a cartilage very much developed in man, and deficient in some animals, and which must not be blended with a production of the same kind which exists loosely under the mucous membrane of the tongue of the dog, the wolf, the bear, &c.; second, of a mucous membrane, the derma of which is extremely strong, which serves, with the median cartilage, for the insertion of all the fleshy fibres, the mucous body of which presents small secretory organs, and numerous eminences, termed collectively, the *papillæ;* some of these are lenticular, others conical, a third kind fungiform, and a fourth species, form the V of the tongue: the latter are composed of fungiform papillæ, which are very much developed, and arise from the base of a small cavity or follicle: third, of intrinsic, transverse, and longitudinal fibres, which are few in the male, but have been observed in animals by Gerdy: fourth, of extrinsic fleshy fibres, among which, the perpendicular come from the genio-glossus; the others, which are longitudinal, come from the hyo-glossus, on the edges and upper face; inferiorly, from the stylo-glossus: finally, some which are transverse, arise from a fasciculus of the stylo-glossus. If we divide a tongue perpendicularly and transversely, we can see that the longitudinal fibres exist in every part under the mucous membrane, and that the perpendicular and transverse fibres are situated in the centre with the median cartilage.

Finally, we have described a *glosso-hyoid* membrane, which is peculiar to man, and attaches the tongue to the body of the hyoid bone; and also two lingual glands, situated under the fimbriated fold of the lower face of the organ, and covered directly by the lingualis muscle and the long fasciculus of the stylo-glossus muscle.

while many others have not received distinct names: another branch of the external carotid artery, the lingual artery, is situated, like the facial, in the supra-hyoid region, and does not quit it; it is first situated inferiorly, and proceeds parallel to the great horn of the hyoid bone, then ascends perpendicularly into the perpendicular portion of the region, and finally again becomes horizontal anteriorly; we must not omit to mention the large branch which is detached from it, and forms the middle artery of the region, the sub-lingual, which sometimes gives off the sub-mental artery, and sometimes arises from it. The veins in this part are rather more superficial than the arteries: thus, the lingual vein passes on the outside of the hyo-glossus muscle: with this exception, they follow their course. Numerous lymphatic ganglions exist around the sub-maxillary gland, the sub-maxillary lymphatic vessels: besides the lymphatic vessels of the region, they receive all those of the face. The nerves are superficial, middle, and deep: the first are given off by the superficial cervical plexus, and by the facial nerve; the second belong to the mylo-hyoid twig of the inferior dental nerve; the last, the lingual, come from the hypo-glossal, the lingual, the glosso-pharyngœal, and the branches of these trunks. The cellular tissue of this region is very loose, except under the skin: it contains a little fat, deeply, but fat is more common superficially, around the sub-maxillary gland.

2. *Relations.* The relations of the numerous organs of this region ought to be studied, first on the median line in the sub-mental portion, then on the sides, around the sub-maxillary gland.

1. We find on the median line, from the skin toward the mucous membrane, which are the two extreme parts of the region; a cellulo-fatty layer, in which the quantity of fat varies; next, the platysma muscles, which are united by the cervical aponeurosis, then within them or under them the superficial nerves and some branches of the sub-mental artery; we then find another layer, formed by the anterior belly of the digastrici muscles, and by the aponeurosis which unites them inferiorly; under this some deep twigs of the sub-mental artery, which cover another plane formed by the mylo-hyoidei muscles united by a raphe, and partially attached inferiorly to the fibrous membrane of the preceding layer. The mylo-hyoidei muscles being turned over, we perceive the two genio-hyoidei muscles; below, the genio-glossi muscles, and finally, still more deeply, upward and forward, the mucous membrane of the floor of the mouth, a prolongation of the sub-lingual gland, and of the duct of Wharton: downward and backward, the tongue, through which we must pass before coming into the mouth or the pharynx.

2. On the sides, from the skin towards the mucous membrane, we find; first, as on the median line, the sub-cutaneous cellular layer, and the

platysma; but the parts under this differ; first comes a cellulo-fibrous layer, attached on the edge and the angle of the jaw; next a net-work formed by the vein, the facial arteries, and their sub-maxillary branches, some lymphatic vessels of the face, the mylo-hyoid twig of the inferior dental nerve, the inferior twigs of the facial nerve, and the superficial cervical nerves of the cervical plexus, in which net-work nearly the whole sub-maxillary gland, and many lymphatic ganglions are imbedded. We observe in this plexus, that the veins are superficial, that the trunk of the facial vein passes on the outside of the gland, while that of the artery is situated on the inside of it, or within it; that the sub-mental artery follows the lower edge of the maxillary bone which protects it; finally, that the mylo-hyoid nerve is situated still more deeply under the gland. All these parts being removed, the mylo-hyoideus muscle is exposed, its external edge extends but a short distance, and we see on the outside of it a part of the next layer, which on the inside lies under the mylo-hyoideus muscle; this plane is formed, upward and forward, by a prolongation of the sub-maxillary gland, by the sub-lingual gland, the duct of Wharton, the lingual nerve, and the sub-lingual artery, which are situated below them; all these parts are confined by the mucous membrane of the floor of the mouth; downward and backward, by the stylo-glossus and hyo-glossus muscles, this latter forming with the genio-glossus a cellular interstice, where the last two portions of the lingual artery are situated, and in which the great hypoglossal nerve terminates. On the outside of the hyo-glossus muscle, we find upon it the preceding nerve, and the lingual vein, which proceed parallel to the horn of the hyoid bone, and likewise the lingual artery, and the glosso-pharyngœal nerve, which are situated more deeply; these last parts rest directly against the body of the tongue, through which we must pass, as on the median line, to come into the pharynx or the mouth.

Varieties. In the child this region is always convex, because there is an abundance of fat under the skin; this afterward diminishes, and then the arched appearance of the region mostly disappears; finally, about the forty-fifth year, the fat again accumulates under the skin, depresses it, and forms the prominences which we have already mentioned.

In the adult male, the beard appears upon this region; in the female this region is always smooth, and as round as in infancy.

The varieties of the organs of this region are few: they appear principally in the sub-lingual artery, which may arise more superficially than in the normal state; it may come, for instance, from the sub-mental artery, and then it passes through the fasciculi of the hyo-glossus muscle. The stylo-hyoideus muscle frequently is not bifurcated at the

lower part; we often find an abnormal muscle in the place of the stylo-hyoid ligament; the latter also may be partially or entirely ossified.

The direction and dimensions of this region are varied by the motions of the hyoid bone; when this bone is elevated, the region is shortened, particularly in its vertical portion; the opposite occurs when the bone is depressed.

Pathological and operative deductions. Wounds of the supra-hyoid space may become serious when they are lateral; in fact, in that part, the facial artery and the sub-maxillary gland may be injured; these accidents may cause a hemorrhage or salivary fistulæ. When the lower part is wounded, particularly by an instrument acting horizontally, the pharynx may be affected. Wounds of the upper part, when caused by the perpendicular action of a wounding agent, may communicate with the mouth. If the lingual artery has been wounded, it may be tied under the hyo-glossus muscle, near the great horn of the hyoid bone, by making a small incision parallel to the bone, which is easily felt; in this operation we divide the skin, the platysma, raise the digastricus and the stylo-glossus, and the hyo-glossus will be interested; the artery being exposed can easily be seized by a director; we must not operate too far from the horn of the hyoid bone, lest the great hypo-glossal nerve be injured; this operation is easily performed on the cadaver, and its inventor, Beclard, recommends it in cases of erectile tumors of the tongue, or where a cancerous portion of this organ is to be removed. Abscesses of this region sometimes open in the mouth, ulcerating through the mucous membrane; these, however, are situated above the mylo-hyoideus muscle; those, on the contrary, which rest on its lower face, point toward the skin; tumors of different characters are often developed there on the outside, and are rarely situated in the sub-lingual gland; they often result from the symptomatic engorgement of the ganglions which surround this gland, which engorgement may supervene in diseases of the face and of the lateral regions of the cranium, and of the head. In ranula, the tumor formed by the dilatation of the duct of Wharton appears in this part, the circulation of the saliva being impeded. This tumor is developed at first only at the upper part, and raises the mucous membrane under which it is directly situated; but a long time elapses before it depresses the region at the lower part, as several authors have stated. The catheterism of the passage of Wharton, when this passage is obstructed, is difficult, but it can be accomplished; it will not, however, cure the patient; in most cases an operation is required, which consists in removing the whole anterior part of the pouch. A great portion of this should be removed, unless we wish the wound to close promptly and the disease to reappear; as Dupuytren advises, the fistulous passage may be kept

open with a double-headed stylet. In the bold and often fortunate attempts at amputation, and even in the extirpation of the lower jaw, successfully performed by Dupuytren, Delpech, Grafe of Berlin, the whole of this region must be detached from the lower jaw; if the centre of the bone alone is to be removed, the facial artery is uninjured, and we divide only the twigs of the sub-mental and sub-lingual arteries; the trunk of the first, which rests closely on the bone, is generally divided. Finally, it is on the mucous face of this region that we pass through the mouth and the larynx, the laryngœal tube of Chaussier, or any other instrument, destined to be introduced into the larynx; when it arrives at the base of the epiglottis, in one of the lateral mucous depressions which we have pointed out, it is carried a little outward and backward, and thus avoiding the epiglottis, it passes with facility through the upper opening of the larynx. Such is the mechanism by which the surgeon introduces foreign bodies into the air-passages; but, if left to themselves, they will not follow this same course, in deglutition for instance; if this were the case, opportunities of observing this passage would be much more common; the disposition of the laryngœal valve, which is depressed from before backward, always prevents this passage: on the contrary, in order that a foreign body may penetrate into the larynx during deglutition, it must pass below the level of this part, and that, by a movement opposite to deglutition, it is carried up below the epiglottis, which cannot then prevent its introduction.

2. PAROTID REGION.

This region is mated and not symmetrical, and occupies the lateral and superior parts of the neck; it is included in the parotid osseous space, and is bounded: anteriorly, by the posterior edge of the ramus of the maxillary bone; posteriorly, by the mastoid process and the auditory passage; superiorly, by the zygomatic arch; inferiorly, by a line drawn horizontally backward, to the level of the angle of the jaw; on the inside, deeply, by the styloid process, its stylo-maxillary and hyoid ligaments, and the anatomical bouquet of Riolan, viz. the union of the muscles and ligaments, which are attached to the styloid process of the temporal bone. Its height is measured by the length of the ramus of the maxillary bone; its breadth varies; the mechanism of the jaw is such, that when this bone is elevated, its breadth is increased above and diminished below; the opposite motion is attended with an opposite change.

The cutaneous face of this region presents only short hairs, and is

marked by a depression which is extremely evident in thin individuals the hairs of the face, which form the beard, suddenly cease in front of it.

Structure.—1. *Elements.* The parotid region has no resisting part, it rests only on the styloid process and the ligaments, which extend it toward the jaw and the hyoid bone; this is, properly speaking, its skeleton; the edge of the ramus of the jaw, its articulation, the mastoid process and the auditory passage, which are its limits, belong to it in part; the same is true of the styloid, the sterno-mastoid, and the digastric muscles; the first bound it on the inside, the others backward and downward. The platysma is the only muscle which truly extends into this region, although to a slight extent; the parotid gland, which fills it, is the most important organ, around which all the others should be grouped, in order to study their relations; it always emerges a little anteriorly from the region, extends into the malar region, embracing the ramus of the jaw; it never extends on the inside beyond the edge of the styloid process, and the edge of the sterno-mastoideus posteriorly, although anatomists assert this; its continuity with the sub-maxillary region is, as has already been said, prevented by a fibrous membrane attached to the angle of the jaw. A number of very small ducts arise from all its granulations and form the radicles of the duct of Steno, which, however, is not situated in this region. The parotid arteries are numerous; all arise from the external carotid artery, which is situated more deeply at the lower part, and more superficially at the upper; its principal branches, which belong to this region, are the temporal and the internal maxillary artery above, the transverse facial artery anteriorly, the auricular arteries posteriorly, all of which emerge soon after arising, and finally some small twigs which are distributed in the parotid gland and come from the external carotid artery or from the preceding branches; the veins follow the course of the arteries, with this exception, that the principal venous trunk is more superficial than the artery. This vein forms the origin of the external jugular vein, and sends an anastomosing branch toward the internal. We also find numerous lymphatic ganglions, which are normally very small; they receive the lymphatic vessels of the temporal, malar, auricular and parotid regions; farther, these ganglions are continuous with the lateral ganglions of the neck. The nerves are superficial or deep-seated; the first belong to the auricular branch of the superficial and cervical plexus, which branch is not distributed entirely in the ear, as its name would indicate; the deep-seated are the facial nerve and its diverging cervical, facial, and temporal filaments, which become more and more superficial as their distance from the primitive trunk increases; after leaving the stylo-

mastoid foramen this trunk proceeds obliquely downward. Finally, the superficial temporal filament of the inferior maxillary nerve, passes through, at the upper part, the whole region, describing a plexus concave superiorly, which embraces the zygomatic arch and the temporo-maxillary articulation. The sub-cutaneous cellular tissue is dense and contains but very little fat; the deep tissue which forms the interlobular tissue of the parotid gland is also very dense but never adipose.

2. *Relations.* In recomposing the parotid region, which we have analyzed, we shall find it formed from without inward of a cutaneous layer, presenting, at most, but a slight down; of a dense layer of a slightly adipose cellular tissue, in which are some fibres of the platysma and the superficial nerves; of a deeper layer, formed by a chain of lymphatic ganglions situated before the auditory passage and on the outer face of the parotid gland which is loose anteriorly, and forms a plane, at the circumference of which are detached; above, the temporal vessels and nerves, either the branch of the inferior maxillary or those of the facial; posteriorly, on the anterior edge of the mastoid process, the posterior auricular artery, and the auricular twigs of the facial nerve, and of the superficial cervical plexus. If we proceed forward two lines from the gland, we come to the filaments of the facial nerve; if we dissect off four in the centre and six posteriorly we come to the trunk. Directly below this plane, which is oblique forward and outward, and is formed by the radiation of the facial nerve, we find the temporo-parotid vein, which is the principal origin of the external jugular vein; below comes also a segment of the gland, then the external carotid artery, which is sometimes situated directly on the styloid process, and sometimes in a groove of the inner face of the parotid gland.

This region is bounded on the inside and downward by the carotid region, which we shall study hereafter; posteriorly, by the auditory passage and the mastoid region; anteriorly, by the malar region, and superiorly by the temple.

Varieties. In children the parotid region is broad at the lower part, because the ramus of the jaw is oblique anteriorly; it is convex on the outside on account of the external fat, and because the lymphatic ganglions are very much developed; in the adult, the dimensions of the maxillary bone, which becomes straighter, have served us as a type; in the old man, the region enlarges at the lower part, and again assumes the characters of infancy.

Sometimes the external carotid artery does not exist; the primitive carotid artery does not divide until below the cranium.

Pathological and operative deductions. In deep wounds of this

region, the external carotid artery may be injured: in these cases, it may be very difficult to tie the artery in the wounded part, on account of the narrowness of the space; it must then be exposed below the region, or the primitive carotid artery must be tied, as was done by Marjolin. These wounds are often followed with very obstinate fistulæ, caused by the injury of the radicles of the duct of Steno. When the jaw is broken, the fragments may be directed toward the parotid gland, and cause in it an inflammation, followed by a greater or less external swelling. This inflammation may affect several of the elements of this glan dfirst, its granulations; second, its interlobular cellular tissue, as in most swellings of the gland in adynamic fevers; third, finally, its numerous veins. This last character is sometimes presented in severe fevers, as we have observed: we believe, also, that this kind of tumor has been overlooked, because it was thought that the pus which came from the divided orifices of the veins escaped from small abscesses in the cellular tissue. Farther, these abscesses may point in the auditory passage after destroying the tissue which fills the grooves of Santorini; they may proceed inward, toward the internal carotid vessels which they compress; but most frequently, they point externally. The parotid gland may swell, in consequence of the saliva continuing in its excretory passages naturally, or by an obstruction to its circulation in the principal duct: schirrous tumors of this region may also be based upon this gland; but we must admit that most of them are situated in the ganglions which cover it. This position also explains admirably what occurs in this case; the gland is crowded inward and wasted: this circumstance has often led to the belief that in extirpating tumors from this part, the parotid gland has been removed, because a considerable depression existed after the operation: this extirpation was seldom performed before the time of Beclard,* who certainly removed it, and opened the external carotid artery during the operation, and this is situated on the internal limit of the gland. Farther, the anatomy of this region shows the danger of this attempt: all the deep nerves of the region are inevitably destroyed, particularly the facial nerve, which is extremely important to the cheek, the neck, and the temple: after the operation, the lips and the alæ of the nose remain paralyzed during the motions of respiration. All the vessels, and even the carotid artery, are necessarily divided. To prevent the bad symptoms which might result from dividing the carotid artery, Beclard recommended to tie it below, before removing a portion of the gland which contains it. This course should be adopted: we thus

* The parotid gland was first extirpated by Prof. Samuel White, of Hudson, New York, in 1808.

avoid a severe hemorrhage, and we gain time to tie the other arteries, particularly the internal maxillary, which passes under the neck of the condyle of the jaw: hemorrhage would certainly ensue from this artery, which is supplied with blood by the anastomoses of its branches. In cases of facial neuralgia, the division, or rather the removal of a portion of the facial nerve, has been performed since the time of Mareschal, particularly by Roux, but generally without success: perhaps this failure may be ascribed to the performance of the operation at the anterior part, or at the centre of the region, in points where the nerve is separated, and its filaments are very remote from each other. To obviate this, Beclard recommended to operate on the trunk of the nerve, where it emerges from the stylo-mastoid foramen; a difficult operation; but it may be performed by making an incision parallel to and near the mastoid process, and by separating the parotid gland which is attached to it: then at the depth of half an inch we find the nerve, which crosses the wound obliquely: we inevitably cut the posterior auricular artery. In the adult, the carotid artery may be compressed at the base of the region, on the styloid process.

ORDER SECOND.

NATURAL REGIONS OF THE INFRA-HYOID PART OF THE NECK.

This order, like the preceding, includes two regions: the *infra-hyoid* or the *laryngo-tracheal*, and the *supra-clavicular*.

1. LARYNGO-TRACHEAL REGION.

This region is unmated, symmetrical, situated on the median line, and forms this part of the neck included inferiorly between the hyoid bone and the sternum, which form its superior and inferior boundaries: it is situated between the two sterno-mastoidei muscles, and is bounded by their anterior edges, which become very prominent when the head is raised and the face is thrown forward.

This region is convex above, and depressed below, and presents a series of prominences and depressions, which are situated from above downward: that of the body of the hyoid bone, the thyro-hyoid space which is terminated below by an edge grooved in the centre, the angular thyroid prominence, the crico-thyroid space, the variable prominence of the thyroid body, and the supra-sternal fossa, which is very distinct in inspiration: finally, upward and outward, a depression

to which we shall recur when speaking of the carotid region, although it is included in the lateral boundaries which we have laid down: at the base of this depression we can perceive, on the slightest pressure, the strong pulsations of the carotid artery.

Structure.—1. *Elements.* This region rests wholly upon the anterior part of the spine, which does not properly belong to it, but which serves as deep limits for it, as does also the longus colli muscle, which rests directly upon it. It is composed of the upper part of the trachea and of its expansion, the larynx, of the thyroid gland, of a portion of the pharynx, and of the esophagus, the latter inclining to the left. These complex organs, particularly the pharynx, which are formed of membranous muscles, &c., need not be described here: we refer for them to works on descriptive anatomy, to which they belong, and in which they are described as small regions. We also find in the laryngo-tracheal region, all the infra-hyoid, the sterno-hyoid and thyroid, the thyro-hyoid, and the scapulo-hyoid muscles, and a small portion of the platysma-myoid muscle: the cervical aponeurosis, which is formed in this part of three layers, as we have seen, when treating generally of the tracheal portion of the neck: two of them embrace the sternum, and are continuous; one, superficially with the subcutaneous tissue of the thorax; the other, deeply with the posterior periosteum of the sternum: the middle, on the contrary, is inserted in the upper part of this bone, which is thus extended to the neck, if we may be allowed the expression. We also number, first, the four thyroid arteries in the normal state, of which the two upper come from the external carotid artery, and give off the superior laryngœal arteries; while the two inferior ascend from the subclavian artery, and give off the small crico-thyroid arteries, which pass through the crico-thyroid membrane: second, the brachio-cephalic trunk, which proceeds obliquely downwards from left to right. The veins are deep, or superficial: the deep go to the thyroid gland, which is very vascular; the superior follow the course of the superior artery, and go toward the internal jugular vein: the central proceed from the side to the same destination: finally, the sub-thyroid descend, and anastomose in a plexus, around the left subclavian vein, which crosses below, in an opposite direction to the innominata artery. Of the superficial veins, the most constant are the two anterior jugular, which follow the anterior edge of the sterno-mastoid muscles to the lower part, curve under them at a right angle, and terminate in the external jugular vein: these veins, which are often very large and anastomose on the median line by transverse branches, descend from the supra-hyoid region, and most frequently communicate, under the angle of the jaw, with the internal jugular vein, sometimes with the external or the superior

thyroid vein: finally, we sometimes find on the median line another vein, which comes from the supra-hyoid region, like the preceding, and terminates in this, or in one of the sub-thyroid veins. One or two lymphatic ganglions are situated in the supra-sternal space: they receive some lymphatic vessels of this region, and some also of the sternal region; but most of the lymphatic vessels of the laryngo-tracheal region go to the lateral ganglions of the neck. We also find there some superficial nerves, filaments of the cervical plexus; some central nerves from the nervous plexus of the great hypo-glossal nerve, and from the internal descending twig of the cervical plexus; some deep nerves, the recurrent, the superior laryngœal,* and some filaments of the tri-splanchnic nerve; some cellular tissue, very loose even on the median line, an arrangement which is necessary for the motions of the principal organ of this region, the trachea; a small quantity of adipose tissue: finally, on the upper and outer part of the larynx, we also find on the inside of this region a portion of the primitive carotid artery, of the internal jugular vein, the par vagum, and the great sympathetic nerve, and some lymphatic ganglions, to which we shall attend hereafter.

2. *Relations.* The first layer of this region is formed by the skin; the last by the spine, before which the longus colli muscles are situated: between these two extreme parts we find successively; from without inward, a sub-cutaneous cellular tissue, very loose even on the median line; the superficial fold of the cervical aponeurosis inferiorly, supe-

* We have attended particularly to the nerves of the larynx: the following are our results. The superior laryngœal nerve is distributed particularly to the mucous membrane and the crypts of the larynx: it also sends off, as Magendie has shown, a filament into the crico-thyroideus muscle, and some others which are less constant, into the arytenoideus muscle. The recurrent nerve is distributed to the two muscles which dilate the glottis, to the aryteno-thyroideus muscle, and finally to the arytenoideus muscle, by a large filament, which passes behind the crico-arytenoid articulation, under the posterior crico-arytenoideus muscle. Thus, the recurrent nerve properly belongs to all the muscles which dilate or contract the larynx, except the crico-thyroideus, which acts but slightly on the glottis. The superior laryngœal nerve belongs almost entirely to the mucous membrane, and by some filaments to the arytenoideus muscle.

We have said that the crico-thyroideus muscle acts but slightly on the glottis. As this opinion differs from that of physiologists generally, we must defend it. This muscle, they say, causes the cricoid cartilage to vibrate on the thyroid, or the second on the first, which it is unimportant; this draws one of the angles of the glottis, tenses its lips, brings them together, and acts as the hand upon a button-hole, the angles of which it draws up. The conclusion is not correct. The crico-arytenoideus muscle certainly tenses the lips of the glottis, but nothing more. In fact, in order that the opening of the larynx may be closed like a button-hole, it should also be opened in the same manner under the influence of a force which produces the curve of its two lips; but experience demonstrates that this does not occur: in the motion of dilatation, the arytenoid extremity of one of the lips of the glottis is simply removed from the other.

riorly the entire aponeurosis, and the two platysma muscles; more deeply, and at the base only, a triangular space, which is bounded posteriorly by the very dense central layer of the cervical aponeurosis: this space readily communicates, under the sterno-mastoideus muscle, with the supra-clavicular region; and we find in it on each side, near the sterno-mastoideus muscle, first, the anterior jugular vein, on the median line; second, frequently a vein, which descends from the supra-hyoid region towards the thyroid plexus; third, some lymphatic ganglions; fourth, below, some venous twigs, which come from the sternal region, and open into the anterior jugular vein. Below the cervical aponeurosis, which is single above, and the two inferior layers, which have already been mentioned, appears a first fleshy layer, formed by the sterno-hyoid muscle, and the anterior belly of the scapulo-hyoid muscles; a second plane, which is also fleshy, and formed by the two thyro-hyoid and the sterno-hyoid muscles, the latter covered by the nervous filaments of the plexus of the great hypo-glossal nerve. All these muscles being removed, we see nearly all the anterior face of the larynx, the thyroid gland concealing the larynx very slightly, and giving origin, by its lower edge, to the deep layer of the cervical aponeurosis (which layer covers the sub-thyroid venous plexus,) and very near the sternum, the left subclavian vein and the brachio-cephalic trunk, which cross and go upward; the first is superficial, is directed obliquely to the left; the second is deep, and proceeds obliquely to the right; they thus form between them an angle, the sinus of which is turned upward, and embraces the trachea. Below the thyroid gland, which proceeds on the outside into the carotid region, and below the sub-thyroid venous plexus, we find the trachea, which is situated more deeply than the larynx. If we now analyze this layer more minutely, in the part where it is formed by the larynx, we find, first, the thyro-hyoid membrane, on the outside of which the superior laryngœal vessels and nerves pass; a membrane, corresponding on the inside to the anterior face of the epiglottis, and to the upper opening of the larynx; second, the thyroid angle, which corresponds to the cavity of the larynx, serves on the inside for the insertion of the vocal cords, and bounds the ventricles of the larynx anteriorly; third, the lateral layers of the thyroid cartilage, sometimes presenting a rounded opening, closed by some cellular tissue: on these layers, the external laryngœal nerve, the superior thyroid artery, and the origin of the inferior constrictor of the pharynx, pass outwardly; and finally, these layers correspond internally upward and backward to the pharynx, downward and forward to a mucous sinus of the same cavity, to the lateral crico-arytenoid and crico-thyroid muscles; fourth, finally, the crico-thyroid space, which is formed laterally by the muscles, and in

the centre by the crico-thyroid membrane, on which the small crico-thyroid artery glides forward, while its numerous twigs pass through the foramina of this membrane: this space corresponds in the larynx to below the level of the glottis. Behind the larynx comes the pharynx, the anterior wall of which is formed in one point by the former; and behind the trachea, the posterior part of which is membranous, we find; on the right, the right recurrent nerve; on the left, the esophagus, which comes to this side, and presents upon its anterior face the corresponding recurrent nerve, and the inferior thyroid artery: still more deeply, a very loose cellular tissue, which covers the longus colli muscles and the spine.

Development. This region assumes at puberty its characteristic size. Until this period we find under the deep layer of the cervical aponeurosis, in front of the trachea, a small part of the thymus gland, which even ascends to the thyroid gland before the sixth month of pregnancy.

Uses. The use of the three aponeurotic layers, which are placed in this part, is to protect the trachea, and to prevent its compression in inspiration, when the external air tends in every part to enter the lungs.

Varieties. This region presents very important varieties; sometimes a middle thyroid artery ascends in front of the trachea, coming from the innominata or from the arch of the aorta; we have seen it as large as the radial artery; the isthmus or one of the lobes of the thyroid gland sometimes extends to the hyoid bone, by one or two slips formed from it, or by a pair of small muscles which we have sometimes seen. Sometimes the superior thyroid artery sends on the crico-thyroid membrane one of its largest branches, which gives off some small twigs to the larynx, and then curves toward the thyroid body, its destination. We have known the superior thyroid and also the inferior thyroid artery to be deficient, or to be replaced by a very small twig; we have known it to come from the carotid artery at the thyroid gland; and very recently also, we have seen it arising, as usual, from the subclavian artery, but passing on the outside of the primitive carotid, and coming superficially into the thyroid gland. The left carotid artery may come from the brachio-cephalic trunk, and pass before the trachea; the right subclavian artery, instead of being formed by the brachio-cephalic trunk, may be the last trunk from the arch of the aorta, or arise between the other trunks; it then always passes between the trachea and the esophagus; we have seen an instance of this.

This region presents a deeper cavity in the male than in the female.

It is longest when the neck is extended; hence this position is required in operating upon it.

Pathological and operative deductions. Wounds of this region are common; it is difficult, on account of the mobility of the deep organs, for their external opening to remain parallel to that of the trachea when this has been wounded; hence arise infiltrations of air, and if a vessel has been divided the blood flows into the trachea. Suicides often select the thyro-hyoid space for their purpose, which they doubtless consider, on account of its feebleness, as best adapted for the purpose of self-murder; the wounds are rarely deep enough to produce a hemorrhage, because these unfortunate persons stop as soon as they have penetrated into the throat and the air issues forth. Nevertheless the epiglottis, which is then divided, may by its depression on the larynx cause severe symptoms. If, as we have seen, the wounding instrument has acted lower on the thyroid cartilage, the vocal cords may have been affected, and the voice changed. Wounds in the crico-thyroid membrane and below it, besides being attended with emphysema and hemorrhage, may be followed by fistulæ, which are rendered serious by their position below the glottis; they prevent the formation of sounds, except when they are closed. A pointed instrument introduced obliquely downward into the supra-sternal hollow, as is done in order to bleed those animals used for meat, would wound the brachio-cephalic trunk and the left subclavian vein at the place where these vessels cross; finally, the wounding body, on deviating to the side, might wound the carotid vessels which are situated near the laryngo-tracheal region. Foreign bodies may exist in the air-passages; sometimes they form in this part, or they come into it from without, or from the esophagus and the stomach, as intestinal worms, for instance. Whatever may be the origin of these foreign bodies, they are generally introduced into the trachea by a motion opposite to deglutition, as we have seen; they irritate the mucous membrane, cause a convulsive cough, during the fits of which, many pulmonary cells are sometimes ruptured, and as authors have observed, emphysema of the infra-hyoid region may occur. In order to extract these bodies the air-passages are opened; this operation was termed by the ancients bronchotomy; this comprises three species; laryngotomy, tracheotomy, and laryngo-tracheotomy; all of them with some modifications are indicated, where a mechanical obstacle opposes the introduction of air into the lungs; whether this is prevented by a foreign body lodged in the esophagus, or the larynx is obstructed by an inflammation, &c.

When we wish simply to cut the crico-thyroid membrane, we divide before coming to it, the skin and the cervical aponeurosis, which is single in this point, and we separate the sterno-hyoid and thyroid mus-

cles. We always divide the crico-thyroid arterial branches and the superficial median vein when it exists. All these vessels should be tied before the membrane is divided.* This may be punctured with a trocar; we even think, that with proper precautions, which we shall mention hereafter, this is the best mode of operating; if we desire a larger opening in the larynx, we divide the thyroid cartilage, as Boyer recommends; it must be cut on the median line, lest the vocal cords be injured; if we wish to carry the incision downward on the cricoid cartilage and the upper rings of the trachea, we necessarily divide the isthmus of the thyroid gland and its vessels, which are often very large, although some authors assert the contrary; hence a hemorrhage which is always injurious and may be fatal.

To operate with safety, we must vary from the course usually prescribed; instead of dividing the trachea and the thyroid gland from within outward, we must commence with the latter, tie its vessels, and afterwards open the trachea. If the blood falls into the trachea, and the patient is in danger of suffocation, we must imitate the course of Roux, who almost restored a patient to life by sucking out the blood which prevented the access of the air. The operation of tracheotomy is still more serious; the trachea is situated more deeply, and also it is covered with the sub-thyroid venous net-work, through the interstices of which it must be divided; in order to this we must cut successively; the skin, the two superficial layers of the cervical aponeurosis, separate the sterno-hyoid and thyroid muscles, divide the last layer of the preceding aponeurosis, and glide the instrument between the sub-hyoid venous branches; the position of the innominata artery and of the subclavian vein, indicates that the trachea must not be divided too low, in order to avoid injuring them; Beclard stated that this accident happened to a medical student who performed the operation of tracheotomy to restore his drowned friend.† When the superior thyroid artery comes on the crico-thyroid membrane, or when an inferior middle thyroid artery exists, these vessels must be tied before the trachea is opened; to perceive them the finger must always be carried to the bottom of the wound.

When a foreign body is arrested in the cervical portion of the esophagus, it compresses the trachea situated before it, and flattens it, and

* By following this direction, we performed this operation the last year, and not a drop of blood escaped into the larynx when the crico-thyroid membrane was divided. The patient was saved from instant suffocation, but died three days after, as the inflammation of the larynx had made great progress.

† Dетharding proposes to perform this operation to restore drowned persons, who, in his opinion, are suffocated by the depression of the epiglottis on the larynx. The experiments of Louis have justified this opinion.

this more easily, because the trachea on this side is membranous; hence also the respiration is more or less obstructed. If this body cannot be extracted or pushed into the stomach, it must be removed by esophagotomy; this operation should be performed on the left side, on account of the deviation of the esophagus; the vessels and nerves in the carotid region must not be wounded, the tumor in its development presses them outward and backward; the inferior thyroid artery, however, will be endangered if, as we have said, it should pass on the outside of the carotid artery, or if we forget that it always glides in front of the origin of the esophagus. The left recurrent nerve will be avoided by cutting the esophagus laterally, the nerve being situated forward. Superficial abscesses of this region may be left to themselves; they seldom point toward the mediastinum which is protected on this side by three layers of the cervical aponeurosis; the middle abscesses have not, however, this arrangement, on account of the weakness of the superficial fold of this aponeurosis; but they readily proceed into the supra-clavicular region, passing under the sterno-mastoideus muscle, gliding on the deep layer of the fascia and accompanying the last portion of the external and anterior jugular vein; to avoid this termination they must be opened early. The deep abscesses often proceed toward the mediastinum, before they can be perceived externally. The same remarks apply to tumors of a different character from abscesses; it is evidently on account of the resistance presented by the cervical aponeurosis to their external development, that the deep tumors compress the trachea and impede respiration; this is seen in goitre; the thyroid gland, when thus affected, has been successfully removed, but the extirpation of the whole organ has often been fatal; in fact, this operation cannot be performed without exposing a number of important parts, and especially without giving rise to an enormous wound, and extreme care and great skill are necessary to avoid a fatal hemorrhage. Serous cysts of the thyroid gland, which Maunoir has removed by irritating injections, and which he terms *hydrocele of the neck*, present nothing peculiar. We shall not mention the ligature of the thyroid arteries proposed to cure goitre, by causing it to waste; this operation is not admitted.

2. SUPRA-CLAVICULAR REGION.

This region forms the lateral and inferior part of the tracheal portion of the neck: it is situated directly above the clavicle, which forms its lower boundary, between the sterno-mastoideus on one side, and the trapezius and the splenius on the other, which bound it anteriorly and posteriorly. It has the form of a triangle, the base of which is situated at the lower part: its extent is always proportional to that of the clavicle, and may readily be estimated externally. Its limits are easily seen: they are those of the supra-clavicular depression, so marked in old men and thin persons, during the elevation of the shoulder. Farther, the outer surface of this portion of the neck is destitute of hairs; the skin plays upon it easily; and the finger, if passed downward and inward, perceives in it very strong arterial pulsations.

Structure.—1. *Elements.* This region rests on the anterior and lateral part of the spine, which bounds it on the inside; below, the clavicle and the first rib are seen: this latter presents above, for the axillary artery, a depression, which is bounded anteriorly by a prominence, where the scalenus anticus muscle is inserted, and the face of this bone looks upward, and slightly outward. Several muscles are partially situated in this region, but most of them pass through it, or terminate there. We see, also, the last cervical inter-transverse muscles; two, and sometimes three scaleni form there a triangular space, the base of which looks to the first rib. The scapulo-hyoideus muscle passes through the region, in a line drawn from the centre of the clavicle to the hyoid bone: before this last point, it is parallel to the clavicle, to which it is attached by a prolongation of the cervical aponeurosis: we find there, also, a very small portion of the platysma muscle. The sterno-mastoideus, trapezius, splenius, and levator anguli scapulæ muscles, which are situated on the limits of the supra-clavicular space, must not be considered in this place. The cervical aponeurosis sends into this region its deep layer, which, after passing under the sterno-mastoideus muscle, terminates on the scapulo-hyoideus muscle, and the posterior edge of the clavicle. The superficial layer of the cervical aponeurosis is here deficient, and is replaced by the platysma. Numerous and very important arteries pass through this region, and send to it some branches. In the first rank, we must place the trunk which goes to the arm. It describes in this place a curve, convex superiorly, the concavity of which embraces the cul-de-sac formed by the passage of the pleura near the first rib. This large artery is termed the *axillary*, when it leaves the space between the scaleni

muscles, and in this space, the *subclavian*. In the second rank, we must mention the branches which come off from the subclavian artery: some proceed horizontally, from behind forward, viz.: first, the transverse cervical, two fingers' breadth from the clavicle; second, the superior scapular, which normally arises along the posterior edge of the clavicle situated between the two layers of the cervical aponeurosis; third, the deep cervical artery, between the transverse processes of the sixth and seventh cervical vertebræ; all go to the posterior cervical or scapular region; others ascend perpendicularly: they are the vertebral, which is concealed by the scalenus anticus muscle; the ascending cervical artery, a branch of the inferior thyroid. All these arteries are accompanied by veins, which present almost the same arrangement, except the axillary vein, which does not pass into the space between the scaleni, but glides along in front of it. The external jugular vein terminates in the axillary trunk, in the anterior part of the supra-clavicular region, after receiving the supra-scapular veins. We find in this part numerous lymphatic ganglions, some of which are superficial, and others deep: they are continuous with those of the axilla, with the lateral ganglions of the neck, and receive all the lymphatic vessels of this region, and even those of the posterior face of the neck, many from the costal region, from the corresponding limb, and some of those which come from the lung, reascending from the mediastinum. This region belongs to the origin of the brachial plexus, for which the space between the scaleni muscles seems formed. The anterior branches of the last four cervical nerves, and that of the first dorsal nerve, contribute to it, but very simply, by an angular union; each of them receives an anastomotic filament from the great sympathetic nerve. From this point arise, the posterior thoracic nerve, the external respiratory nerve of Charles Bell, the diaphragmatic nerve, which rests successively on the external anterior and internal parts of the scalenus anticus muscle, and all the other branches of the superficial cervical plexus, which is itself situated in the sterno-mastoid region. Some of these branches descend, as the supra-clavicular, the supra-acromial, and the deep cervical nerves; others ascend, as the mastoid, the auricular, and the superficial or sub-cutaneous cervical nerves, which also proceed forward: the spinal nerve is simple, or divided into several filaments, passes through the upper part of the supra-clavicular space, and soon emerges, to go to the trapezius muscle. But little fat exists in this part: the cellular tissue is very loose in every part except between the skin and the platysma muscle.

2. *Relations.* We have stated the most important arrangements of the organs we have mentioned, and those which are least known: we shall now attend to their connexions. The first layer is formed by

the skin, which moves easily, not only over the platysma, but far below it: next comes a thin but dense layer of cellular tissue, which intimately unites the skin with the platysma muscle; this forms a third plane, with a cellular layer, in which it terminates posteriorly. Below, is a layer formed by the descending filaments of the cervical plexus, which are single inferiorly, but united to the spinal nerve above, and to the external jugular vein anteriorly. This latter, in terminating, passes through the following layer, formed by the scapulo-hyoideus muscle, the deep layer of the cervical aponeurosis anteriorly, a dense cellular layer posteriorly. Below, at a distance from the clavicle, and in the direction mentioned, are situated the transverse cervical and the superior scapular arteries, the subclavian vein, which is hardly perceptible, it is so entirely concealed between the first rib and the clavicle. In a still deeper layer, appears anteriorly the scalenus anticus muscle, crossed by the phrenic nerve, and on which the small ascending cervical artery rests; posteriorly, the scalenus posticus muscle, which is divided into several distinct fasciculi. In the space between these two muscles, we find the origin of the brachial plexus, which rests against the scalenus posticus, and is situated at the upper and outer part of the triangular space: below, on the first rib, the axillary artery rests against the posterior side of the scalenus anticus, being separated from the vein by this muscle, and from the brachial plexus by a marked cellular space: farther, these parts are united by a very loose cellular tissue, which is not adipose. Finally, under the scaleni, we find, the transverse processes, and the vertebral artery which enters into their canal at a height which varies, the last inter-transversarii muscles, and the deep cervical artery between the sixth and seventh transverse processes.*

Development. The development of this region follows that of the clavicle, and of the neck in general.

Varieties. This part presents several important varieties: they relate to its height, and the more or less abnormal arrangement of the vessels and of some muscles. In the motions of depressing the shoulder and of drawing it forward, this region enlarges very much, and its principal artery is seen in a greater extent: opposite motions produce

* Such is our idea of the supra-clavicular region in the normal state, and as it was described by Beclard: it is formed of all the organs situated at the base of the supra-clavicular space, the limits of which are so well defined. Thus presented, this region is simple, natural, and admits very readily of applications in a surgical point of view; but its character is entirely changed, if we include in it the sterno-mastoid muscle, a part of the trapezius, and the posterior muscles of the neck: in other words, if it be bounded by lines drawn from the sterno-clavicular articulation to the anterior part of the mastoid process, and from the posterior part of this latter to the acromio-clavicular articulation.

in it an opposite arrangement. In inspiration, the supra-clavicular sinus of the pleura ascends higher: sometimes the transverse cervical artery arises from the axillary artery in the space between the scaleni, or even on the outside of this space. In these two cases, it commonly passes through the meshes of the brachial plexus; at other times, as in plate third, the two terminating branches united at their origin in the normal state, arise separately; one, the superficial branch of the subclavian artery; the other, the deep twig of the axillary artery, between the scaleni muscles. The superior scapular artery sometimes presents this latter arrangement: it is often a remote branch of the transverse cervical artery, and then it is not situated in the supra-clavicular space. The vertebral artery often enters into the canal of the transverse processes unusually high: the passage of the vein with the axillary artery, in the space between the scaleni, is very rare: we have seen it once. The scapulo-hyoideus muscle sometimes terminates in this region on the clavicle: sometimes, also, the scalenus-medius muscle of Sœmmering separates the brachial plexus into two fasciculi: it is rarely interposed entirely between the artery and the nerves.

Pathological and operative deductions. Wounds of the supra-clavicular region may be extremely serious: they may be immediately fatal, if the principal arterial trunk is opened: a severe hemorrhage may also result from the injury of the transverse cervical and superior scapular arteries. The position of this latter exposes it to be opened by the fragments of a fractured clavicle, if they are pushed back with violence. An injury of the brachial plexus is attended with severe pains, and a more or less perfect paralysis of the corresponding extremity: it may be injured by wounds of the posterior part of the space. A difficulty of respiration indicates a wound of the diaphragmatic nerve anteriorly. Finally, in inspiration, and when the shoulder is depressed, a wounding instrument, carried even horizontally to the clavicle, might injure the axillary artery, and open the cavity of the pleura, in the space between the scaleni: still more would this penetrating wound produce the same symptoms, if the instrument should act in the same place obliquely downward and inward. In persons affected with phthisis, the deep lymphatic ganglions of the supra-clavicular space are often engorged: this is explained by the anatomical fact that these ganglions receive some lymphatic vessels of the lungs. Tumors of this region, appearing in the lymphatic ganglions, or only in the cellular tissue, point towards the skin, if situated on the outside of the aponeurosis, but proceed to the axilla if covered by this aponeurosis. Abscesses present these characters to a great degree; they should, therefore, even when superficial, be opened early, lest they should burrow through the aponeurosis, and descend into the axilla.

Superficial incisions in this part, if not contra-indicated, should be perpendicular, in order not to wound many of the superficial nerves: deep incisions should be transverse, to avoid the transverse cervical and superior scapular arteries. These incisions always cause pains, which the patients refer to the top of the shoulder, according to the course of the supra-acromial nerves. As this region contains the origin of the brachial plexus, we must here apply leeches, blisters, &c., when we wish to act on this plexus, in paralysis of the thoracic extremity. The portion of the external jugular vein which occupies this point, should be compressed in bleeding from the neck; but it is never opened here, because it is situated too deeply. The axillary artery, the pulsations of which are readily felt through the skin on the first rib, may also be compressed here in operations on the arm. To attain this, it is necessary, as when we wish to tie it, to depress the top of the shoulder, and draw it forward; then to press with the finger from above downward, and a little from without inward, so as to act perpendicularly to the rib; we thus place the artery between two opposite planes of resistance, one of them passive, the other essentially active. This compression, also, may be made with an instrument; but the finger is preferable. In cases where the principal artery is wounded, it might, perhaps, be imprudent to lay it open in order to tie it. In fact, the mere enlargement of the external wound might destroy the patient, before the vessel could be tied: it would be better to compress it on the first rib. The ligature of this trunk is indicated particularly in aneurisms of the axilla; but in these cases, the clavicle is often crowded so much upward, that the operation is impossible, the supra-clavicular space being very much contracted. To prove this, we shall merely mention that Sir Astley Cooper was obliged to renounce it in this case. Farther, to lay bare this vessel, a vertical or transverse incision has been recommended. We have already shown by anatomy, that if the first exposes the supra-clavicular nerves less than the second, the transverse cervical and superior scapular arteries are more liable to be wounded. For these reasons, we prefer the transverse incision. It should not be made too near the clavicle, in order to avoid the superior scapular artery, nor more than one finger's breadth from it, lest the transverse cervical artery be divided. The layers, which are divided from without inward, are, the skin, the platysma, and the supra-clavicular filaments of the cervical plexus: we then push inward the lower extremity of the external jugular vein, with the scapulo-hyoideus muscle; we divide a fibro-cellular layer, which is situated on the posterior part of this muscle, and we soon meet anteriorly with the scalenus anticus muscle; this is followed to the first rib, and behind it we there find the artery, which is raised from within outward by

introducing one of the fingers into the wound to meet the director, and prevent it from injuring the plexus, or from raising one of its branches: the loose cellular tissue which surrounds this vessel facilitates this last period of the operation. Nevertheless, during this operation, the patient experiences severe pains, which dart down into the corresponding limb, and even to the ends of the fingers. This phenomenon is caused by disturbing the brachial plexus. In order to facilitate this operation, we must divide the whole or a part of the scalenus anticus muscle. If we should do this, as Dupuytren advises, we must be careful, in the first case, in dividing the muscle, not to cut the phrenic nerve, which is situated on its inner part. If this nerve should be divided, the diaphragm would lose its contractile power on the corresponding side; if simply the external part of the scalenus muscle should be divided, this accident would be avoided: this precaution may be dispensed with. We can then conceive, that in tying the axillary artery, how necessary it is to remember the anatomical varieties which have been pointed out; for if, on raising the axillary artery, we perceive that it gives off a large branch near the place where it is to be tied, the ligature must be applied above this origin, or upon the trunk and the branch which arises from it: for want of this precaution, a hemorrhage may supervene, as when the external iliac artery has been tied below the epigastric, although, however, the anatomical relations are not exactly the same. If the scapulo-hyoideus muscle impedes the operation, it must be raised on a director and divided. We shall speak hereafter of the ligature of the subclavian artery on the inside of the scaleni muscles.

PARAGRAPH SECOND.

ARTIFICIAL AND COMPLIMENTARY REGIONS OF THE TRACHEAL PORTION OF THE NECK.

These regions are two; one of them is formed by the group of organs which rest on the two faces of the sterno-mastoideus muscle, the other, by the union of those which surround the primitive carotid artery below, and the internal carotid which is continuous with the former, above. A little reflection will show the importance of this division to complete the topography of the neck, and in order not to separate the relations of the carotid artery and sterno-mastoid muscle; we think it will be advantageous to students, because it will assist the memory, and practitioners will find it of great surgical importance.

1. STERNO-MASTOID REGION.

This region has extremely definite limits; it is bounded anteriorly and posteriorly by the anterior and posterior prominent edges of the sterno-mastoideus muscle, above by the mastoid process of the temporal bone, and below by the sternum and the clavicle. Its form is that of a very elongated rectangle, and its direction is oblique downward and forward, so that it passes almost from the anterior to the posterior part of the neck. Farther, we observe that it is formed by the group of organs which correspond to the two faces of the sterno-mastoideus muscle, when the head is elevated on the spine, and the face is directed forward.

The sterno-mastoid region on the outside forms a prominence which is more or less marked in its whole extent by the muscle which serves as its base. In dyspnœa we remark on its centre a line which crosses it from above downward and from before backward; it is the prominence of the external jugular vein.

Structure.—1. *Elements.* The lateral face of the cervical vertebræ corresponds to this region in almost every part, but the anterior face corresponds to it only at the lower part, of which, however, the sterno-mastoideus muscle forms the base. Numerous other organs are found in it, but in so small an extent that we shall not enumerate them; their description offers nothing peculiar to topographical anatomy; we will only remark that the cervical plexus, improperly called the superficial, occupies this point, with a chain of lymphatic ganglions, which are called the sub-sterno-mastoid.

2. *Relations.* The relations are very simple on the outside of the sterno-mastoideus muscle; the organs form there very distinct layers, but this is not the case below it; we however think that if presented methodically, the structure of this part may be understood by every one.

1. *On the outside of the sterno-mastoideus muscle,* we find successively, a first layer formed by a thin skin covered at most with a slight down: next a cellulo-fatty tissue of a moderate degree of density; a third layer formed in the centre by the platysma, below by the superficial layer of the cervical aponeurosis, above by a very dense cellular tissue, which however is not lamellar; below this layer, and in the centre of the region, a loose cellular tissue which is never adipose, and in which proceed from above downward, and from before backward, the external *jugular* vein, and the cutaneous cervical filaments of the cervical plexus, which filaments cross the vein, interlacing in the

centre of the neck; the auricular filament from the same plexus ascends perpendicularly, above the centre of the region, in this same cellular tissue. Finally, another layer is formed by the sterno-mastoideus muscle, and through the inner half of this the spinal nerve passes.

2. *Below the sterno-mastoideus muscle*, the relations must be studied *inferiorly* below the scapulo-hyoideus muscle; in the *centre*, between this muscle and the mastoid portion of the splenius; and *superiorly* on a level with the latter.

Inferiorly we find a very loose cellular layer, which is not adipose, and in which the curved portion of the external anterior jugular vein passes near the clavicle; next come the deep layer of the cervical aponeurosis, and the scapulo-hyoideus muscle to which it is united: then, on a level with the external fasciculus of the sterno-mastoideus muscle, a portion of the carotid region, which we shall examine hereafter: but at the clavicular portion of the same muscle, we perceive; the subclavian vein below, and then rising successively, the supra-scapular and transverse cervical arteries, surrounded with lymphatic ganglions, more deeply the scalenus-anticus muscle, crossed by the phrenic nerve, and placed on the inside near the inferior thyroid artery. All these parts being raised, we come to the subclavian artery, when it has arrived at the first rib, and has given off all its normal branches; it is situated more superficially on the right side, and its origin on this side also is near the brachio-cephalic trunk; the thoracic canal crosses posteriorly that of the left side.

In the centre, under the sterno-mastoideus muscle, we find the superficial cervical nervous plexus, between which a number of lymphatic ganglions are situated; below, the ascending cervical branch of the inferior thyroid artery, the insertion in the transverse processes of the rectus capitis anticus major, the scaleni, the levator anguli scapulæ, and the splenius colli muscles; then the transverse processes, and the vertebral artery in their canal.

Superiorly, when the sterno-mastoideus muscle is raised, we observe a first layer formed simply by the splenius capitis muscle: below, a second formed anteriorly by the posterior extremity of the digastricus and the complexus minor muscles, posteriorly by the occipital artery and veins which come from below the complexus minor muscle, by the atloidal extremity of the two oblique muscles of the head, and the outer edge of the complexus major muscle: under the complexus minor, a portion of the occipital vessels, then the rectus-capitis-lateralis, and finally the vertebral artery between the atlas and occipital bone.

Varieties. Sometimes two external jugular veins exist: (Pl. III.) The transverse cervical and superior scapular arteries often arise out

of this region in the supra-clavicular region; this has been mentioned already.

Pathological and operative deductions. It follows from our remarks, that wounds of the sterno-mastoid region are particularly dangerous at the lower part, because if they are deep, they may be attended with the lesion of the carotid artery and subclavian vessels: in the centre the cervical plexus may be injured, and above, the occipital vessels and the vertebral artery; the vertebral artery, however, is more easily wounded between the atlas and the axis, where it forms a curve, which places it on a level with the summit of the transverse processes. It has been recommended to tie the subclavian artery at the lower part of this region on the tracheal edge of the scalenus-anticus muscle: this operation is difficult on account of the depth of the vessel, and particularly because of the nearness of the carotid artery and the union of the subclavian and jugular veins; this operation, in our opinion is rash, since the subclavian artery cannot be reached until it has given off all its branches; and as these serve to restore the circulation of the corresponding limb, they necessarily preserve the blood fluid in the trunk as far as the ligature; hence, when it comes off, hemorrhage is almost inevitable. Farther, to give an idea of the difficulty of this operation, we will add, that to perform it we must divide successively; the skin, the superficial layer of the cervical aponeurosis, the sterno-mastoideus muscle, and the deep layer of the cervical aponeurosis: we must avoid the anterior jugular vein which passes through this latter and push forward the subclavian vein, the supra-scapular and transverse cervical arteries upward, leave on the inside the internal jugular vein and the inferior thyroid artery, and then only can we raise the artery on the inside of the scalenus-anticus muscle, being careful also not to take in front of it the phrenic and pneumo-gastric nerves, and behind it the thoracic canal on the left. In this region, the external jugular vein is opened when we wish to bleed from the neck, but we must not open it directly in the centre of the neck, in order to avoid the superficial cervical nerves. The sterno-mastoideus muscle is often pushed outward by ganglionnary tumors, which are generally symptomatic. Supra-sternal and supra-clavicular abscesses burrow easily from one of these regions into the other, following the deep layer of the cervical aponeurosis below the sterno-mastoideus muscle: we have seen several instances of this. Finally, it has been advised to divide the sterno-mastoideus muscle at the base of this region in cases of permanent rotation of the head, which is caused sometimes by a convulsive contraction, and sometimes by the paralysis of one of these muscles. In the first case, it is recommended to divide the convulsed muscle, in the second that which is paralyzed:

in the former case, the operation may succeed, but in the latter, the head will be rotated in the opposite direction, by the sound and healthy muscle. The inferior and deep relations of the sterno-mastoideus muscle show the necessity of dividing it upon a director, to avoid the large vessels below it. Boyer thinks that this operation is rarely indicated. Richerand, however, has frequently performed it and with success.

2. CAROTID REGION.

This important region is formed of all the organs which surround the primitive carotid artery and its internal branch; it represents a triangular space, the boundaries of which are determined as follows: posteriorly by the vertebral column and the rectus capitis anticus major and longus colli muscles: internally, by the pharynx above, the esophagus and trachea below; anteriorly and externally, by the parotid region and the internal pterygoid muscle above, and by the sterno-mastoid region below and in the centre. This region, which is thus natural to a certain extent, extends the length of the neck; it proceeds from the base of the skull to the thorax.

Structure.—1. *Elements.* Not to mention the numerous organs included in the carotid space, it is occupied by the carotid artery, which ascends a little obliquely on the outside to just below the larynx, and is situated in a perpendicular plane above: on leaving this point, it divides into two branches: one is superficial, and goes to the parotid region; the other is deep, continues in the course of the trunk, and forms, towards the skull, a variable number of more or less distinct curves. Most of the branches of this large vessel have received special names. Two smaller, but remarkable arteries, pass through the carotid space; one is the *inferior thyroid*, which presents there a vertical and a transverse portion: the other is the *inferior pharyngeal* artery. The carotid artery is attended by its vein, the *internal jugular* vein, which receives at the upper part, above the larynx, the facial, lingual, pharyngeal and occipital veins, and a twig of communication from the external and the anterior jugular veins; the internal jugular vein receives only at its lower part the last two; and in the centre, the lateral thyroid veins. In fine, the internal jugular vein corresponds exactly to the carotid arteries, only those of its branches which correspond to the divisions of the external carotid artery, do not unite in one trunk, but open into the jugular vein at different heights. Numerous lymphatic ganglions occupy the carotid space, below the level of the angle of the jaw: they are very rare superiorly,

but are not entirely deficient there.* The pneumo-gastric nerve passes completely through this region, and sends off superiorly its pharyngeal and superior laryngœal filaments, and inferiorly the cardiac: the cervical portion of the great sympathetic nerve also exists there in every part, giving off externally filaments of communication to the cervical nerves, internally the superficial and middle cardiac nerves, and anteriorly, the carotid and pharyngeal filaments. The great hypo-glossal nerve and its descending filament, which is a continuation of it below, the glosso-pharyngeal and the spinal nerves, are the other nervous parts of the carotid region. All the elements are united by a very loose cellular tissue, forming perhaps an external sheath for the carotid artery. There is no fat in this region.

2. *Relations.* To proceed methodically, we must examine successively the parietes of the carotid region, and the relations of the parts within it.

The parietes, in most points, are known to us, as they are formed by the regions already described. The posterior wall is formed by the anterior face of the spine, which is covered by the rectus capitis anticus major and the longus colli muscles. The internal wall is formed by the union of the pharyngeal and laryngo-tracheal regions. The external and anterior wall belongs, superiorly, to the parotid region, and to the masseteric portion of the malar region; inferiorly, it is formed by the lower part of the sterno-mastoid region; but in the centre, in a triangular space which is bounded posteriorly by the prominence of the sterno-mastoideus, on the inside by the larynx, and superiorly by the angle of the jaw, it is formed of thin layers, in which the carotid vessels are superficially situated. These layers have not yet been described. In proceeding from without inward, we find in this point, the skin, a thin cellular layer, the platysma, the superficial cervical nerves of the cervical plexus anteriorly, the auricular nerve from the same plexus posteriorly, the external jugular vein passing on the outside of the digastricus muscle, and sending from above downward under it, a twig towards the internal jugular vein or one of its branches. The digastricus and the stylo-hyoideus muscles being raised above, we come in every part to a venous plexus, in the meshes of which are numerous lymphatic ganglions; this plexus is formed by the facial, lingual, pharyngeal, laryngœal, superior thyroid, and occipital veins, and the twigs of communication between the external and anterior jugular veins with the internal. Below this venous net-work, we see the reflected portion of the hypo-glossal nerve, the trunk of the external

* Must we conclude from the small number of lymphatic ganglions existing under the base of the skull, that the brain has no lymphatic vessels, and that the few which come from this cavity, belong to the meninges?

carotid artery and its principal branches, some of which diverge anteriorly, as the superior thyroid, the lingual, and the facial arteries; another, the occipital, is directed a little obliquely backward. The relations of the organs of the carotid space are very simple: we find in every part of it the primitive carotid, and its continuation, the internal carotid artery, which rest against the internal wall of the space; near them is the internal jugular vein. If we separate these two vessels slightly, we discover between and behind them, the pneumo-gastric and the great sympathetic nerves; this latter on the outside ot the former. In the highest part of the carotid space, the principal artery is near anteriorly and on the inside to the inferior pharyngeal artery, which comes from the external carotid artery: the spinal, great hypo-glossal, and the glosso-pharyngeal nerves, are united at first to the pneumo-gastric and great sympathetic nerves in the space between the carotid artery and jugular vein: but on a level with the atlas, the relations change; the spinal nerve goes obliquely backward and passes before the jugular vein; the glosso-pharyngeal and great hypo-glossal nerve, the latter lower than the former, cross the anterior part of the carotid artery, and go inward: finally, in this upper portion of the carotid region, the pharyngeal and superior laryngœal filaments of the pneumo-gastric nerve, always glide behind the carotid artery in this upper portion of the carotid region, to go to their destination: in the centre of the neck, the carotid artery is directly in contact on the outside, with the descending branch of the great hypo-glossal nerve, which soon unites in an arch, with the internal descending branch of the cervical plexus, which branch passes in its turn obliquely before the internal jugular vein: near this point, an arterial twig, which leaves the superior thyroid artery, and goes to the sterno-mastoid muscle, passes obliquely through this region, crossing the direction of the principal vessels: a little below, a lateral vein proceeds from the thyroid gland toward the internal jugular vein, passing transversely before the carotid artery, which is covered also by the thyroid gland: the transverse portion of the inferior thyroid artery, on which the middle cervical ganglion rests, crosses posteriorly the direction of the vessels and nerves.

Development. At puberty, the internal and external carotid arteries are nearly of the same size; before this period, the internal is larger in proportion to the external, the nearer we approach to the period of birth and that of conception: this fact may be explained by the unequal development, at these different ages, of the organs to which these two vessels go. In the child and the fetus, the curves of the internal carotid artery are very distinct; they disappear in part as age advances, and it would seem that the artery always possessed its normal length

when first formed, and that it was folded only to accommodate itself to the extent of the neck at this period.

Varieties. In the female, the internal carotid artery is smaller in proportion to the external, than in the male.

A. Burns has cited some cases where the primitive carotid artery continued under the skull before dividing. We have never seen this variety; but we have often observed that the external carotid artery arose from it at the angle of the jaw: in these cases, the superior thyroid and the lingual artery did not come from it, but from the primitive carotid artery. Burns also mentions the premature division of this artery. We have seen the inferior thyroid artery come from the primitive carotid at the thyroid gland. Finally, when speaking of the laryngo-tracheal region, we mentioned the passage of the preceding vessel before the carotid artery in a case where its origin was normal. The superior thyroid artery may arise from the primitive carotid artery high up. Finally, the common carotid artery may present a great number of curious varieties in its origin, which we shall pass over, because they do not affect the region of which we are speaking. Sometimes we find in the adult the internal carotid artery curved in the form of an S, as in the child; we obtained a specimen of this from the dissecting rooms of the faculty.

Uses. The position of the carotid vessels in a broad space, filled with a loose cellular tissue, is one of those minute precautions taken by nature to give the utmost possible liberty to the circulation of the head, the organs in which are so important. In the carotid space, however, the tortuous arrangement of the artery, under the skull,* visibly tends to diminish the force of the circulation in the delicate substance of the brain; doubtless, also, the same cause may be assigned for the greater curves of this vessel in the child and the fetus, in whom the brain is very much developed, and at the same time very soft, and therefore requires to be protected from the velocity of the circulation, particularly at this age.

Pathological and operative deductions. Wounds of the centre of the carotid space may be very serious, although they are not deep; to be satisfied of this, it is only necessary to place the finger on the side of the larynx: we feel there almost immediately the pulsations of the primitive carotid artery, which might thus be easily wounded. Abscesses or effusions of blood in this region very promptly extend upward

* In most of the carnivorous mammalia, the internal carotid artery presents under the brain an arrangement which will give an idea of the uses of its curves in man. It divides into a great number of branches, which afterwards reunite and form a new trunk. These different branches anastomose in a plexus around the pituitary body and form the *rete mirabile* of authors.

and downward toward the mediastinum, from the very great laxity of the cellular tissue, and also because prevented by no fibrous layer. The lymphatic ganglions which have been mentioned, often swell in diseases of the head or neck; those situated under the angle of the jaw are enlarged in inflammation of the isthmus of the fauces, because they receive all the lymphatic vessels which come from this point. Their position near the nerves and vessels, explains the compression which they sometimes exercise upon them, and the dyspnœa* or the obstruction to the circulation in the brain caused by them. We have found in the upper part of the right pneumo-gastric nerve, in a subject brought to the dissecting rooms, a tuberculous mass as large as a pea; we could learn nothing in regard to the symptoms during life. This individual had doubtless been affected with dyspnœa, as in animals where in physiological experiments, one of the par vagum nerves had been divided, or as in the patient observed by Andral. The ligature of the primitive carotid artery is not difficult, but the above details must be remembered; this vessel has often been tied for aneurisms or fungous tumors, or to prevent hemorrhage when the artery or its branches have been wounded. Upon whatever part of the neck this operation is performed, we must always make the incision before the sterno-mastoideus, and divide successively the skin, the platysma myoides muscle superiorly, inferiorly the superficial layer of the cervical aponeusoris, and its deep layer under the scapulo-hyoideus muscle, the latter may be divided if it is in the way, and also the sterno-mastoid twig of the superior thyroid artery; we must also remember the position of the lateral thyroid veins when they exist, and the variety where the inferior thyroid artery passes before the carotid; we must then carefully open the sheath of the carotid artery, avoid the descending branch of the great hypo-glossal nerve, and push the artery from without inward, in order not to take up with it the internal jugular vein, and the pneumo-gastric and great sympathetic nerves which are near it, the first on the outside, the last two outward and backward. We must not carry the instrument for taking up the vessel too near the vertebral column, lest the inferior thyroid artery be injured, on which it rests below. Wardrop has treated an aneurism of the primitive carotid successfully, by tying this artery between the tumor and the capillary system. This is the first successful case for which the carotid artery is better adapted than any other: in fact it gives off no branch before its bifurcation, the blood circulates there contrary to the direction of its specific gravity, and the circulation of the head after the operation is not for a moment interrupted, on account of the numerous

* Andral in the *Bulletins de l' Athénée de médecine*, July 1826, mentions a case where the pneumogastric nerves were wasted, by being compressed by the tumefied lymphatic ganglions. The patient in the latter periods of life was affected with a remarkable dyspnœa.

anastomoses of the arteries; all these circumstances easily admit the coagulation of the blood in the artery and tumor below the ligature. We think that now, a surgeon should be censured, if he should permit a patient to die rather than imitate the remarkable example of Wardrop. The primitive carotid artery was tied for the first time by Sir Astley Cooper; Dubois, however, would have performed it before him, had not the patient died from an attack of apoplexy, some days before that appointed for the operation. We may be called to tie the external carotid artery at its origin in cases of wounds, or following the example of Beclard, or in order to extirpate the parotid gland more safely. To tie this vessel, we must divide the skin, the platysma muscle, and some nervous filaments of the cervical plexus; we must then look for it below and between the meshes of the venous plexus, which has been mentioned as existing under the angle of the jaw.

ARTICLE II.

POSTERIOR PORTION OF THE NECK.

This is formed by the group of organs which rest on the spinal face of the upper part of the spine, and presents but one very simple region, that of the nucha, the *cervical region* of Chaussier.

REGION OF THE NUCHA.

The nucha, *cervix*, has very definite limits; the external occipital protuberance above, the spinous process of the atlas below, and laterally, the edges of the sterno-mastoideus and trapezius muscles, which also bound the sterno-mastoid and supra-clavicular regions.

The region of the nucha is concave from above downward, and convex transversely; its transverse diameter is contracted in the centre, and gradually enlarges as we approach the skull or the back.

Most of the deep face of this region rests on the spine, except above, where it is connected with the portion of the region of the base of the skull, intercepted between the occipital foramen and the external occipital protuberance. Its superficial face is loose, cutaneous, and covered

with hairs in its upper third. On the median line, the raphe is very distinct, and we can here feel the summits of the spinous processes of the vertebræ, particularly at the lower part; at the upper part the occipital protuberance always exists on the median line, and at the lower part, on the prolongation of the plane of the occipital foramen, is a depression which varies in depth, a kind of cervical fossa.

Structure.—1. *Elements.* The annular part of the cervical vertebræ forms the skeleton of this region, to which, consequently, the cervical portion of the vertebral canal belongs. We remark, that the vertebral layers are very distinct from each other, particularly at the upper part; that the yellow ligaments which fill their spaces, are easily perceived posteriorly, when all the muscular parts are removed, and that on their level, the parietes of the vertebral canal are weak. The posterior cervical ligament exists in man,* although as a rudiment, and is attached to the external occipital crest and protuberance above, and to the summit of the last cervical spinous processes below. The nucha is particularly remarkable for its numerous muscles: some belong to it entirely, and others in part. The first are the inter-spinales, the posterior inter-transversarii, the recti and obliqui muscles, and the superior fasciculi of the transversalis colli muscles. Among the second may be mentioned, the two complexi,† the splenius, the transversalis colli, and the levator anguli scapulæ muscles, which extend but little below the nucha; the trapezius, the rhomboideus, the serratus minor posticus superior, and the upper extremity of the sacro-lumbalis, which exist in this region in but a small part of their extent.

Four considerable arteries send branches into the region of the nucha: the vertebral, the deep and the transverse cervical, and the occipital arteries. The first two are deep seated; the vertebral presents there its last curve, and the deep cervical terminates there. The last two are superficial, and of them, only the horizontal portion of the trunk, and the origin of the last curve of the occipital artery, exist there. All these arteries anastomose extensively with each other, and establish vascular communications between the carotid artery

* In the large quadrupeds, this ligament is enormous. It is formed of a very elastic yellow fibrous tissue, and forms a spring, which, by its elasticity alone, straightens the head on the spine, while it does not prevent the head from being flexed towards the neck by the power of the muscles.

† The complexus major muscle may be considered as a transversalis colli muscle: its directions, insertions, and uses, are the same. If we call to mind the analogy of the occipital bone and of the vertebræ, this comparison of the muscles will become still more striking. This muscle, however, contrary to the opinion of authors, is not inserted in the transverse processes, but in a groove which separates them from the articular processes.

from which the last arises, and the subclavian artery, which gives off the first three. The veins accompany the arteries. The deep lymphatic vessels all go to the lateral lymphatic ganglions of the neck: the superficial vessels, on the contrary, are divided between the preceding ganglions and those of the axilla.

The nerves of the nucha come almost exclusively from the posterior branches of the sub-occipital nerve, and from the cervical nerves, which are joined by the spinal nerve, and some descending filaments of the superficial cervical plexus: all these nerves, which are at first deep, become superficial as they advance, and finally terminate by numerous twigs in the skin.

The cellular tissue of this region is loose between the muscles, and very dense under the skin: in this last point, also, it is much more compact above than below, which renders the dissection of the muscles of this part very difficult. Notwithstanding its density, this cellular tissue has no lamellar arrangement, and it is an abuse of the term aponeurosis to call it so, by showing its continuity with the fascia cervicalis. Fat exists, particularly, in the sub-cutaneous tissue, and perhaps also deeply behind the occipital foramen; generally speaking, it is not abundant. The skin is firmer and thicker than upon the tracheal portion of the neck: it is hairy and very follicular at the upper part.

2. *Relations.* In proceeding from the skin toward the spine, we discover, successively; in the nuchal region, a layer of skin, a cellulo-fatty tissue, which is very dense, particularly at the upper part, attaching the skin to the deeper layers very firmly, and containing, directly under the occipital bone, the ascending portion of the occipital vessels, with a considerable nervous filament, which attends them to the occipito-frontal region; next, we find a fleshy layer, formed by the trapezius and sterno-mastoideus muscles, between which the preceding nerves and vessels pass upward; these two muscles, however, are not contiguous, and between them we see in this layer a part of the splenius and of the levator anguli scapulæ muscle: a second fleshy layer, which lies under the trapezius and the sterno-mastoideus muscles, is formed from above downward, by a part of the complexus major, the splenius, the levator anguli scapulæ, the upper part of the rhomboideus muscle, and that of the serratus posticus superior, which passes beyond the first; if the last two be removed, the lower extremity of the splenius may be perceived, and also the highest fasciculi of the sacro-lumbalis muscle. Next, comes a third fleshy layer: it is visible when we have turned outward the levator anguli scapulæ muscle, and have entirely removed the splenius; it seems formed, in almost every part, by the complexus major and minor, which rests on the former,

below also by the complexus minor, by the transversalis colli, and by the sacro-lumbalis, the three united and almost blended in one fasciculus: below the complexus major muscle is an interstice which is more cellular than the others, which interstice contains the deep nerves and vessels of the region, the ascending part of the deep cervical artery, the branches of the vertebral artery, and the posterior twigs of all the cervical nerves: below, is a fourth muscular layer formed; at the lower part, by the superior fasciculi of the transversarii muscles; above, by the two oblique and the posterior recti muscles of the head; the first two muscles, with the rectus major muscle, form a triangular space, the base of which corresponds to the posterior occipito-atloidal ligament, to the posterior arch of the atlas, and in the area of which appear the last curve of the vertebral artery, the twigs which it sends into the neck and the posterior filaments of the sub-occipital nerve. Finally, all these parts being removed, the posterior face of the spine is exposed at the upper part, we can discern there the distinctness of its layers and the breadth of its inter-laminar spaces, which arrangement shows at the posterior part the yellow ligaments.

Development. The development of this region presents nothing peculiar. The sub-occipital fossa is more and more distinct, in proportion to the age. It is very much marked in the old man, on account of his thinness, and also because the head being inclined forward, requires a continual muscular effort to prevent it from falling entirely forward, in consequence of which, the muscles which circumscribe this depression become more prominent.

Varieties. In porters, this highly muscular region is very much developed; but its development is slight in females and children. Its upper transverse extent is in relation with that of the posterior part of the skull on which it rests. Some persons, by examining this point, have pretended to be able to determine the genital powers of different individuals, in accordance with the opinion of Gall, who considers the cerebellum as regulating this function. When the neck is extended, this region is shortened, but it is lengthened when the neck is flexed.

Pathological and operative deductions. Wounds of the nucha are not dangerous when they are superficial, The slight hemorrhage with which they are attended is always easily arrested by compression or by applying a ligature. Deep wounds may be very serious, and even immediately fatal. A pointed instrument may in fact penetrate between the layers of the vertebræ to the vertebral canal; this is particularly easy at the level of the sub-occipital fossa, between the occiput and the atlas, or between this last and the axis. The weakness of the wall of the vertebral canal in this point seems to be generally known, for it has several times been selected by murderers for the fulfilment

of their criminal designs. Fractures of the vertebral layers are rare in this region, because they are protected by the muscles more than in any other part, and because the very short spinous processes are not superficial, and are concealed between this latter, and hence counterblows are less frequent. We have mentioned in another place our ideas upon dislocations. Anthrax or furonculæ, appear frequently in this region. These tumors cause there pains, which are more intense in proportion to the internal adhesion of the skin to the subjacent parts. The nucha is connected with the orbital region by sympathies, which cannot be demonstrated satisfactorily by anatomy, but which, however, are not less real, as daily observation will show; hence, the propriety of selecting this region for applying issues in affections of the orbit, and particularly in ophthalmia. When the inflammation produced by these causes is very acute, the lateral ganglions of the neck are swelled, because these organs receive the lymphatic vessels of the neck. When a seton is applied to this part, we must be careful not to wound the muscles; we have known tetanus and death to be caused by their injury. The hemorrhage which sometimes ensues after this operation, from the superficial ramifications of the occipital and transverse cervical arteries, can always be arrested by compression.

CHAPTER II.

OF THE CHEST.

The chest, *pectus*, *thorax*, is that important portion of the trunk which, in the mammalia, specially protects the respiratory organs, the heart, and its principal vessels. Its external limits are fixed and well defined: the extremity of the sternum, and the edge of the first rib, which may be readily felt on the limits of the neck, at the upper part; at the lower, the base of the bony chest, which is represented on the right and left by a curved line, very prominent anteriorly, less so posteriorly: this line is the upper boundary of the abdomen.

The chest is situated at the union of the upper third with the two lower thirds of the body. Its direction is oblique from above downward and from behind forward; this arrangement must be seen by an examination made anteriorly and on the sides, for the posterior part

of this portion of the trunk describes an arch of a circle, the cord of which is perpendicular, and the convexity is directed backward.

The form of this region, when the shoulders are not considered, may be referred to that of a truncated cone, the base of which is at the lower part. Its height, breadth, and thickness, are estimated by considering the transverse, vertical and antero-posterior diameters: their absolute length varies, and is of but slight importance: this is not true of their relative extent. The vertical diameter is larger on the outside, at the level of the ribs, and a little smaller posteriorly, near the spine, still smaller at the height of the sternum, and always exceeds the last two. The transverse diameter, in the normal state and the adult, is larger, in turn, than the antero-posterior.* Farther, we remark, that these diameters, when measured externally, are far from furnishing the capacity of the thorax by their measurement: the convexity of the spine on the inside, and that of the diaphragm also, show it. The thoracic portion of the trunk presents a cavity, which is separated into two secondary cavities by a median septum. The term chest sometimes designates the cavity alone, although we cannot conceive of it without the parietes which form it. It is flattened from before backward, supporting above, and on the outside, the shoulder, with which it forms the axilla. It presents nothing general but the raphe, which is distinctly marked.

Structure. The skeleton of the chest is formed entirely by the thorax; its muscles are intrinsic or extrinsic: among these latter the most remarkable go toward the shoulder, and concur by their angular separation of the thorax, to form the axilla. Vessels, nerves, &c., are found here as in every other part. The relations present nothing general; the extreme layers are the skin on one side, the pleura on the other. Finally, this region presents two distinct portions, the *pectoral* and the *abdominothoracic.*

Development. The development of the chest resembles that of the trunk in general; it occurs by two pieces, which are first separated laterally, and afterwards united on the raphe; when once formed, the antero-posterior diameter is very much developed during the whole of pregnancy, and in some measure at the expense of the other two; this arrangement depends on the great flexion of the spine anteriorly, and on the premature development of the organs situated in the cavity on the median line. After birth, the transverse diameter suddenly increases, on account of the establishment of respiration: but at puberty particularly, this diameter is enlarged, so as to exceed in the adult the antero-posterior diameter.

* This arrangement exists only in man.

Varieties. In the old man, as the spine again bends forward, the articulations of the ribs become rigid, these bones are depressed on the spine, the antero-posterior diameter becomes proportionally and even absolutely larger than the others.

In the female, especially anteriorly, the height of the chest, compared with that of the body, is a little less than in the male; the antero-posterior diameter is proportionally more extensive than the transverse; notwithstanding its apparent slope above, the chest in the female still retains the form of a cone, the base of which is situated at the lower part, the superior transverse extent not depending upon a real enlargement in this point, but on the greater separation of the shoulders, which is caused by the length of the clavicles. We see also that the chest of the female preserves many of the characters of infancy.

Individual variations are perhaps mcre numerous here than in any other parts; sometimes the antero-posterior diameter is very much developed at the expense of the transverse, or the latter at the expense of the former; the respiration in those individuals in whom the first conformation exists, is very difficult; they are disposed to phthisis; the second type has a marked influence on the circulation, and disposes to diseases of the heart; some males have the chest of the female, and *vice versa.*

Uses. The chest, by the parietes of its cavity, serves as a protecting organ; farther, it moves very remarkably in respiration; and although these motions are not connected with our subject, we must not only mention their existence, but also the progressive diminution of their extent, from birth to old age. We shall see hereafter the pathological deductions from these opinions.

Pathological and operative deductions. The thoracic portion of the trunk may sometimes be entirely deficient, as in the *athoraco-cephalic fetuses:* sometimes its upper half only is deficient, in the pectoral portion, as in *apectoro-cephalia.* We not unfrequently observe a want of union on the median line, either in one point or in nearly the whole of the chest; hence anterior or posterior fissures. Rachitis often produces in the skeleton of this portion of the trunk different deformities, in which all its parts participate; the most frequent is a curve to the left, by which the two thoracic cavities are considerably contracted, on the left side by the approximation of the ribs, on the right, by the abnormal prominence of the spine this side.

These general ideas being laid down, let us examine first the parietes of the thorax, then its cavity, and the organs which it contains.

ARTICLE I.

OF THE PARIETES OF THE THORAX.

The parietes of the thorax are generally divided into anterior, posterior, lateral, superior, and inferior; but this division is much too artificial to form the regions of this part of the trunk. These regions, moulded on the skeleton, are six in number, exclusive of that of the mediastinum, which will be examined when speaking of the cavity of the thorax: they are the two costal, the sternal, the dorsal, and the diaphragmatic regions, and that of the upper wall.

1. COSTAL REGION.

Most of the circumference of the chest is formed by the ribs and the organs which rest on them or are situated in their interstices; they constitute the costal region, which is extended on the anterior and posterior faces of the trunk, and corresponds particularly to its lateral part.

Its limits are very exact; they are anteriorly the heads of the sternum and the sternal region; posteriorly and deeply the vertebral column, and more superficially, the external prominence of the sacro-spinalis muscle in strong individuals; above and below, the upper and lower edges of the first and twelfth ribs.

The surface of this region is convex and directed obliquely from above downward and from within outward; it is remarkably high in the centre, and on leaving that point it diminishes progressively anteriorly and posteriorly. The costal region is thinner forward and at the base than in any other portion; at the upper part its thickness is increased by that of the shoulder which it supports.

The costal region presents two faces; one of them is internal, is concave, smooth, and is lined by the pleura; the other, the external, is convex, cutaneous in most of its extent, except above, where it forms one of the parietes of the axilla. This face, on the anterior and posterior part of this region, is raised and rendered plane by the fleshy masses which are detached angularly to go to the shoulder, and which thus form the parietes of the axilla; anteriorly, this cutaneous face of the costal region presents the relief of the inferior edge of the pectoralis

major muscle, and below some oblique prominences, which mark the digitations of the serratus major muscle, which prominences are seen in the works of painters and sculptors. We shall mention hereafter the mammæ, a small distinct region, a sort of appendix to this.

Structure.—1. *Elements.* This region rests on the ribs and their cartilages which form its skeleton; these parts leave between them spaces which are broader above and at the union of the rib with its cartilage, and longer, on the contrary, in the centre, than in any other part. Each rib is extended forward, and articulated, as has been said, with the sternum, or with the two other ribs between which it is situated. This latter arrangement is peculiar to the false ribs, the cartilages of which are articulated by special facetts, and are united by some loose fibrous attachments; in these points, the intercostal spaces do not exist. The posterior articulation is formed by the contact of the ribs with the bodies of the vertebræ and their transverse processes, on which they form an arch posteriorly; farther details belong to descriptive anatomy. The muscles of this region are situated in the intercostal spaces, under and on the outside of the ribs. In the intercostal space we find the two planes of the intercostal muscles, which are composed of fleshy and aponeurotic fibres and have opposite directions; the external layer is directed from behind forward, and the internal layer from before backward; these circumstances increase the resistance of the intercostal spaces. The external layer does not extend entirely to the sternum; it is there replaced by a strong aponeurosis, the fibres of which are directed like those of the muscle; the same arrangement exists posteriorly for the internal layer, which does not extend to the spine. Under the ribs we often find some small muscles, the infracostales; the triangularis sterni muscle always exists anteriorly, the diaphragm and transversalis abdominis muscles bound it below. On the outside of the ribs, the serratus major muscle belongs entirely to this region, although it terminates on the scapular region. The two pectoral muscles, the trapezius, the rhomboideus, the latissimus dorsi, the serrati, the obliquus abdominis externus, the rectus abdominis, and some fibres of the platysma myoides muscle, are also situated in this region in a greater or less portion of their extent. The rectus muscle is covered there anteriorly, by a prolongation of its abdominal sheath. The arteries of this region are remarkable for their arrangement; they are the infracostal, the intercostal, or the extracostal. The first come from the trunk of the internal mammary artery, which corresponds to the anterior part of the region, superiorly by its trunk, inferiorly by a considerable branch which follows the circumference of the base of the chest. The branches of this vessel extend to the internal portion of the costal region, and farther to each of its

intercostal spaces, by two twigs, and finally, to the supracostal portion, by some branches which penetrate the muscles. The arteries of the intercostal space are numerous: they are, posteriorly, the intercostal artery and a twig which it sends towards the upper edge of the inferior rib; anteriorly, two twigs of the mammary artery which anastomose with the preceding arteries; all extend their ramifications toward the pleura, the skin, and the intercostal muscles; the principal intercostal branches which come into the skin, pass through the external muscles in the centre of the intercostal spaces. The extracostal arteries come from the trunk which goes to the thoracic extremity, and are given off from the transverse cervical or the posterior scapular arteries, the two thoracic and the common scapular arteries. Some arterial anastomoses which are important to the collateral circulation exist in this region, between the intercostal, the mammary, the posterior scapular, the common scapular, and the thoracic arteries. Two veins generally accompany each artery; some lymphatic ganglions, which are commonly but slightly developed, exist on the course of the intercostal and mammary arteries; they receive some superficial and a part of the deep seated lymphatic vessels. Most of the superficial lymphatic vessels go to the axillary ganglions. The nerves are intercostal or extracostal: the first send their twigs, like the arteries, not only to the space they occupy, but also toward the pleura and the diaphragm internally, and towards the skin externally; each intercostal nervous trunk gives off one external trunk to the centre of its space; that of the upper trunk belongs to the arm, the others remain on the outside of the region. The extracostal nerves come from the brachial plexus; they are the thoracic twigs; we find there also some supra-clavicular filaments of the superficial cervical plexus. The trunks of the vessels and nerves of the costal region are generally situated deeply; their twigs usually proceed from within outward and come to the skin; they also give some perhaps to the pleura, a circumstance highly important in the structure of this region. The cellular tissue is loose in every part, and but little adipose tissue exists, except superiorly and anteriorly; we however find a little fat in every part. The skin is remarkable only for its sensibility; the pleura adheres but slightly and in every part; the mammary gland will be examined hereafter.

2. *Relations.* The relations of the costal region are complex, particularly on the outside; they are extremely important; in order to mention them methodically, we must consider them successively in the supracostal, the intercostal, and the infracostal regions.

1. *Supracostal portion.* This should be divided into two halves, an upper and a lower. The first is rendered more complex by the presence of the shoulder; if we remove this, or rather if we separate it

from the trunk at the axilla, we find from without inward; first, the posterior thoracic vessels and nerves resting on the outer face of the serratus major muscle; second, the serratus major muscle, through which pass the brachial twigs of the intercostal nerves and some arteries; third, more deeply a very loose cellular tissue, then the ribs and the intercostal spaces. In front of the axilla are parts which go toward the shoulder and form the anterior wall of the axilla, to which parts we shall attend hereafter; on the inside, they present themselves in the following order; the skin, a loose cellular tissue in which we find some fibres of the platysma and the supra-clavicular nervous filaments, the mammary gland, which forms a small separate region, the pectoralis major muscle presenting a cellular interstice situated on a line oblique downward and outward; finally, under this muscle near the sternum and above, we come to the ribs and their cartilages, while in the centre is situated the pectoralis minor muscle which extends a little below the sternum; under the pectoralis minor appear the first portion of the serratus major muscle and the ribs. We find behind the shoulder and always in the upper half of this extracostal portion; the skin, a very dense cellular layer, a first muscular layer formed by the trapezius, the rhomboideus, and the latissimus dorsi; a second layer which includes the whole of the rhomboideus; finally, a third formed by the serratus minor muscle. In the lower half of the extracostal portion, under the skin and the sub-cutaneous cellular tissue, through which pass the external filaments of the intercostal vessels and nerves, we find a fleshy layer formed from before backward by the rectus muscle in its sheath, the obliquus externus, the lower anterior part of the serratus posticus superior muscle, and the costal portion of the latissimus dorsi muscle: under these the ribs and their spaces appear in almost every part; posteriorly, between them and the latissimus dorsi, we see a small part of the serratus posticus superior, and the serratus posticus inferior muscles.

2. *Intercostal portion.* Under the preceding layers, we find the ribs and their spaces, which are alike in every part, and are closed by two layers: one of them is external; it is the external layer of the intercostal muscles, and the aponeurosis, by which it is continued forward; the other, the internal, is the deep layer of the intercostal muscles and its posterior aponeurosis. Between these two layers, the vessels and nerves are situated posteriorly at equal distances from the two ribs, and in the centre their trunks extend along the upper rib which slightly protects them, while one of their branches follows the upper edge of the lower rib, and finally, being reduced to simple filaments, they occupy the centre of the space.

3. *Infracostal portion.* Under the ribs, and the layers which fill

their interstices, we come in almost every part to cellular tissue, and then to the pleura; in some points, we sometimes find the infracostal muscular fasciculi, and the internal mammary vessels always present themselves anteriorly, two lines from the sternum above, and at its edge below, where they are protected by adjacent cartilages, which are united. Under these vessels, we find the triangularis sterni muscle below, and the pleura, to which they are adjacent, above.

Development. The costal region, and also the ribs which constitute the base of it, form early; but in the earliest periods, it is flat. It does not assume its characteristic convex form until after birth, and particularly until puberty.

Varieties. The pressure of corsets in females depresses this region at the lower part, which is naturally prominent, and causes it to assume a roundness which is greater at the centre than above. The costal region sometimes extends higher, in consequence of the development of a thirteenth upper or lower rib; there is then one more intercostal space. Sometimes two ribs are united in one, posteriorly or anteriorly, which slightly modifies the intercostal spaces. In females, the costal region is flatter than in males; it is also thicker, on account of the predominance of fat. We not unfrequently see two infracostal arteries, one of which occupies the position of the internal mammary artery, the other glides under the ribs in the centre of the region: this supernumerary branch may come from the subclavian or from the first intercostal artery.

Uses. All this part is moved upward and downward, by the sternum, in the motions of inspiration and of expiration: in motions upward, the intercostal spaces are enlarged; they are contracted in motions downward. The ribs cannot be carried backward by any external muscle, on account of the point of support which they have on the corresponding transverse process; we must, however, except the false ribs. The mobility of the ribs, considered separately, increases from above downward; but viewed as connected by the sternum, they cannot be depressed or elevated except in an equal ratio;* the ribs, also, rotate around their cord, but in the lower and middle ribs this motion is greater than in the upper ribs. These reflections furnish a subject for important remarks.

Pathological and operative deductions. This region is often deformed by rachitis: it may be depressed inward or may project out-

* It is evident that we allude here to the absolute motion performed by the anterior extremity of each rib, and not to this motion proportional to the length of the costal ray; that the first rib is more fixed, (an opinion admitted by Haller, and rejected by Majendie,) appears to us to be proved, by the shortness, size, and resistance of the first costal cartilage, and also by the want of an angle to this rib, which circumstances deprive it of the rotatory motion executed by the others around their cord.

ward. When the thoracic portion of the spine curves to the right or left, the costal region, corresponding to the side toward which the curve exists, is flexed, the ribs approach, the intercostal spaces become very narrow; the region bulges, on the contrary, on the opposite side, the ribs are removed from each other, and the intercostal spaces become broader. Sometimes the costal region is depressed, so as to become convex internally, even when no rachitis exists, in persons who have recovered from an old thoracic effusion, followed by the crowding back and the adhesion of the lung to the mediastinum: in fact, when the liquid is absorbed, the lung cannot dilate as quickly as the absorption takes place, and then the costal region inclines inward, to prevent a vacuum. The ribs may be fractured directly, or by the action of a pressure which increases their curve. In the first case, the fragments, if pressed inward, may cause severe injuries. The upper ribs, which are protected by the shoulder and the muscles, are rarely fractured; this is true also of the lower ribs, on account of their great mobility. The middle ribs are protected by neither of these causes, and hence they are often fractured. The displacement of the fragments of the fractured ribs is slight, because they are supported by those which are uninjured: the latissimus dorsi, or the pectorales muscles, may nevertheless draw one of the fragments upward: the other may be depressed by the obliquus externus, the rectus, or the triangularis sterni muscle, according to the rib which is fractured. The very great and constant mobility of the costal region prevents the union of the fractured pieces; this, however, may be counteracted by bandaging the chest tightly, so that the respiration shall be performed by the diaphragm. Fractures of the costal cartilages are rare, on account of their suppleness: their slight degree of vitality explains why they are imperfectly united by the formation of the external osseous ring, which keeps the fragments in place. When these cartilages are ossified, however, their fractures unite like those of the ribs. We have seen instances of both modes of union. We cannot conceive how the ribs can be dislocated posteriorly. Buttet, who has written a memoir upon this subject, was doubtless deceived by a fracture of their posterior parts. The cartilages of the last ribs sometimes glide over each other anteriorly, constituting a trivial kind of dislocation. Wounds of this region, if confined to the supracostal portion, are always very slight; at the upper part, however, they may cause hemorrhage, which may come from the thoracic arteries. If the wound be deeper, the ribs or the costal cartilages may be injured: the wounding instrument which proceeds from above downward, injures the ribs much more easily above, where one of their faces looks upward, the other downward: the lower ribs, from an opposite arrange-

ment, are more easily wounded by an instrument which proceeds horizontally. If the wound penetrates into the intercostal space, a hemorrhage may supervene, from an injury of the intercostal artery, or of the branches of the mammary artery. Among the modes employed to arrest this hemorrhage, simple plugging is preferable. When the wounding instrument acts near the sternum, and affects most of the anterior wall, the internal mammary artery may be opened: this artery is more liable to injury superiorly, on account of the breadth of the intercostal spaces, from its size, and particularly because it is situated two lines from the sternum; it is less liable to be wounded below, from opposite reasons, and particularly because its nearness to the edge of the sternum in a measure protects it. We shall speak hereafter of penetrating wounds, in which this whole region is interested. The simultaneous distribution of vessels and nerves from common trunks to the pleura, the diaphragm, and to the skin, explains those pains felt superficially in pleurisy, and the efficacy in these cases of leeches and counterirritation, and emollients applied to the sides of the thorax, and finally the singular sympathy which connects the skin of this region with the diaphragm, and the advantage taken of this sympathy in asphyxia, to re-establish respiration. The operation of empyema may be performed on all the intercostal spaces. Verduc, Desault, and Boyer, recommend the lowest parts to be selected, with variations to the right and left, which we shall mention hereafter. Laennec prefers the most central space, because this is the lowest part in laying down on the side. Farther, we must select the exact centre of the intercostal space: we select the central transverse point, to avoid posteriorly the injury of the twig of the intercostal artery, which goes obliquely toward the lower rib; and in order not to wound anteriorly the intercostal artery itself, which leaves the lower rib; we prefer the central longitudinal point, so as not to wound the intercostal artery above, or the twig of this vessel, which extends along the lower rib, below. This operation is necessarily attended with the incision of the skin, of a cellular layer, of the obliquus externus, of the serratus anticus superior muscle, of the intercostales, the cellular tissue under the pleura, and the pleura. Senac's advice to puncture the pericardium, by plunging a trochar into the third intercostal space, and two inches from the sternum, to avoid the internal mammary artery, which method was followed by Desault with some modifications, should never be performed, because, independent of its exposing the heart to injury when hydro-pericarditis does not exist, the pleura is necessarily opened.

From the costal region proceeds a small secondary region, which completes the first, viz. that *of the mamma*. This region is slight in the male, but is very much developed in the female. In works on

descriptive anatomy, we find the fullest details in regard to its form, size, and position, the prominence of the nipple, its areola, the glands near it, and the depression which bounds this region inferiorly.

Structure.—1. *Elements.* We will only mention that the mammary region is formed essentially of the mammary gland; that its excretory passages are united in fasciculi by a cellulo-vascular tissue, and form the nipple; that its granulations are united, in more or less distinct masses, by large cellular interstices, and that its circumference extends vaguely on the muscles. An abundance of fat and cellular tissue exists in this region. It receives arteries from two sources; some come to it from above downward, and from without inward, the thoracic vessels; the others proceed from within outward; these are branches of the internal mammary artery, and are fewer. The veins form two layers, one is superficial; it arises at the base of the nipple, and its twigs do not accompany the arteries, while the other is deep, and presents an opposite arrangement. Most of the lymphatic vessels go to the axillary ganglions; the deep, however, terminate in the internal mammary, and intercostal ganglions. The nerves come from the thoracic and intercostal twigs, and also from the supra-clavicular filaments of the cervical plexus. The skin and a small mucous membrane complete all the elements of this region.

2. *Relations.* The nipple is formed by the mucous membrane, a cellular tissue, which is not adipose and very vascular, and which contains some of the nerves, and the principal milk-passages. In the rest of its extent, the region is successively formed, first by the skin, and in the centre by the mucous membrane which is more adherent there; second, by a cellular and adipose tissue, in which the supra-clavicular nerves are situated above, and the veins and the superficial lymphatic vessels in every part; next comes the mammary gland; some celluloadipose matter is interposed between its lobes, which are united by very dense, and apparently fibrous, cellular bands. The gland itself rests particularly on the pectoralis major, and slightly on the pectoralis minor and serratus superior muscles.

Development. This region is rudimentary in the male. In the female it is developed only at puberty; it collapses after the cessation of the menses, and it constantly becomes at different periods of life, the centre of an irritation; as at puberty, at each menstrual period, during gestation, and at the turn of life; hence we can thus conceive of the frequency of its morbid affections. The sensibility of the whole region, if we except the nipple, is rather slight.

Pathological and operative deductions. At the different periods we have mentioned, this region is often the seat of an inflammation, which may affect only the nipple and its areola. Abscesses often form in this

region in nurses; if the inflammation be superficial, it is not serious; but if it is deep, pus infiltrates between the segments of the gland, disunites them, the latter become hard, and fistulæ always exist. Encysted tumors are often developed in the mammæ; cancer seems to affect this gland particularly; it generally commences at the base of the nipple, which soon disappears, being drawn inward by a kind of contraction of its cellular tissue, and of its passages; the cancerous tumor soon extends, and radiates like the lobes of the gland; these are the diverging claws of the crab, to which the ancients compared cancer; it is worthy of remark, that cancer is always preceded by a kind of fibrous change of the interlobular tissue, in which the disease primitively appears. The axillary ganglions are next engorged, and in the later periods, the mammary and intercostal ganglions; hence the pains under the sternum, mentioned by every author, for which anatomy accounts satisfactorily. The skin of this region is very much relaxed, when the arm is brought near the trunk; hence the precept, when the axillary glands are not engorged, to operate on cancer of the breast by incisions perpendicular to the axis of the body, in order that union by the first intention may be facilitated. Tumors in the axilla can be extirpated more easily by making an incision obliquely upward and outward, toward the axilla; this operation causes the patient to feel pains in the neck in the course of the supra-clavicular nerves. In advanced cancers, the disease extends beyond the mammary region, attacks the pectorales muscles, the ribs, and the pleura. If we are bold enough then to undertake the operation, ought the roots of the evil to be removed? Should the ribs and the pleura be amputated? Richerand has resolved this difficulty, by a most remarkable operation, and has proved by experience, that life may be preserved, notwithstanding the penetration of air into the chest. Precautions, however, should be taken, to prevent its continual ingress.

2. STERNAL REGION.

The division of the body into regions ought not to be marked off upon its anterior or posterior faces: otherwise the regions would be all artificial, and the student would suffer from the consequences of this defective mode, and would find the parts of the body which are formed even very naturally, parcelled out in such a manner as to afford but an imperfect knowledge of them. We have here an important instance of the truth of this remark: if the whole anterior wall of the thorax should form but one region, we should be obliged to refer to this, the anterior part of the intercostal spaces, which it is important

to regard entire. These inconveniences are avoided in this point, by comprising in the sternal region only those parts which are connected with the sternum, which method is indicated by the denomination of the region.

The sternal region, which makes a part of the anterior wall of the thorax, is composed of the organs which rest on the sternum anteriorly. Its length is much less than its breadth; its thickness is less inferiorly; it is, in fact, determined almost entirely by that of the bone. Its limits are very natural and are easily perceived externally; they are, superiorly and inferiorly, the two extremities of the sternum; laterally, the edges of this bone which may be felt by pressing upon the superficial layers. This region is oblique downward and forward.

The sternal region presents two faces; one is cutaneous, the other is deep: the first is hairy in man, and is depressed longitudinally at the raphe, particularly in adults and very strong individuals; farther, we remark a series of transverse prominences, the relief of the edges of the crest of the sternum: one of them, the most constant, is situated at the union of the upper with the two lower thirds of the region and results from the angular union of the first pieces of bone: sometimes, but rarely, we feel a deep median depression, which indicates an abnormal formation of the bone; a prominence appears at the upper and outer part of each rib which belongs to the sterno-clavicular articulation. The deep face of this region is united with the mediastinum.

Structure.—1. *Elements.* The sternum, which is very spongy, forms the base of this region. Its ensiform cartilage is frequently cleft, and it presents a foramen, which Dulaurens and Riolan have wrongly considered as more frequent in the female. This bone contributes superiorly, by a concave facet oblique backward and outward, to the sterno-clavicular articulation; the posterior ligament of this articulation is weaker than the anterior: two other ligaments are there seen, the costo-clavicular and also the inter-clavicular, which is extremely important, as it extends the region superiorly. The sternum is also united on the outside to the cartilage of the true ribs, between which it is as it were suspended. Its articulations are compact; but few muscles exist in this region and none of them belong to it exclusively: the two pectoral muscles intercross on the median line by their aponeurosis, the sterno-mastoideus above, the xyphoid fasciculus of the rectus abdominis below: posteriorly, the termination of the triangularis sterni muscle. The arteries arise from the trunk of the internal mammary artery, situated on the outside of the limits of the region: a small twig frequently comes from the neck, passing on the upper groove of the sternum, it arises from the inferior thyroid artery, from one of

the external branches of the subclavian artery, or from this latter. The veins attend the arteries: the lymphatic vessels proceed partly into the cervical ganglions, partly into those of the axilla, and partly into the adjacent internal mammary ganglions. The cellular tissue is dense in the centre and but little exists there: less is found externally: but little fat exists in this point where the skin is hairy and very follicular, as in every region covered with hair.

2. *Relations.* The layers of this region are, the skin which is attached on the median line, a cellular layer which is not fatty, and in which the tendons of the sterno-mastoid and the pectoral muscles, and some fibres of the rectus abdominis muscle, are situated; next the sternum covered posteriorly with a dense periosteum and with some fibres of the triangularis sterni muscle.

Development. In the fetus, the sternal region is very low proportionally; it increases till the period of puberty in the male: in the female, it preserves the arrangement of infancy.

Varieties. In some individuals, this region is elevated in the centre, as in birds: this arrangement is attended with a transverse contraction of the whole chest; in others it is very much depressed inferiorly: every person, in whom the chest serves as a point of support during labor, is singularly disposed to this affection, which is presented in the greatest degree by shoemakers, especially when they begin to work early in life, while the sternum is still semi-cartilaginous. In this region we sometimes find a special muscle which Meckel* regards as the repetition of the rectus abdominis muscle; sometimes it unites this and the sterno-mastoideus: sometimes it is situated out of this region; the sterno-mastoid tendon often descends very low to the rectus muscle.

Uses. This region is suspended between the regions of the ribs and the clavicle, and protects by its resistance the deep organs, and retreats before injury. Its motions are sometimes those of elevation and sometimes of depression: the first are such that while they occur, the whole region is carried forward, and particularly downward; it seems to have a vibratory motion. The whole shoulder executes on the upper part of the region motions of elevation, confined by the costo-clavicular ligaments, and of depression which are soon arrested by meeting the first rib; its motions anteriorly are weak, on account of the direct tension of the posterior muscles of the shoulder, but much more extensive posteriorly, although also confined at last, by the anterior muscles of the shoulder: finally, this sterno-clavicular articulation admits of a motion of circumduction composed of all these.

Pathological and operative deductions. We not unfrequently find

* See Doane's Meckel, vol. 2, p. 99.

this region to be partially or entirely cleft; the internal organs are then almost naked; the frequent bifurcation of the xyphoid cartilage, as also the foramen, which is sometimes seen in the sternum, must be considered as the least possible degree of this conformation. The depression of the sternum, if very much marked, as in shoemakers, impedes the motions of the heart; the posterior curve of the xyphoid appendage cannot impede the motions of the stomach as has been imagined; and this also has been considered as a cause of gastralgia, only by ignorant physicians, who are incapable of forming a correct opinion in respect to the true cause of disease. The sternum, on account of its spongy nature and of its mobility, cannot be broken except by a violent force.* Luxation of the clavicle anteriorly on the sternum is explained by the extensive motions of the shoulder posteriorly, and not by the arrangement of the anterior ligament, which is the strongest; in this luxation the head of the clavicle is thrown forward, raising the sterno-mastoid tendon. Wounds of this region are not very serious, when they are confined to it. Venereal tumors are often developed in the sternum, on account of its superficial situation. Boyer and Genouville have removed a great part of the sternum for an affection of caries, which often appears in this bone. In Boyer's case, the internal mammary artery was divided, because this surgeon carried his instrument beyond the external limits of the region. It is not certain that Galen performed this operation. Skieldrup and Laennec have proposed to trepan this region at the lower part in order to puncture the pericardium. This method is recommended, as the signs of dropsy of the pericardium are very uncertain; by this mode the envelope of the heart can be examined, and the presence of the liquid may be ascertained before it is opened. Trepanning also is indicated to remove a circumscribed caries of the sternum, and to evacuate the pus from an abscess in the mediastinum. This operation has been proposed to facilitate the ligature of the brachio-cephalic trunk; we shall speak of it in another place.

3. DORSAL REGION.

The dorsal region, a portion of the great spinal region, occupies specially the posterior face of the chest; its limits are exact: it is bounded laterally by the sacrospinalis muscle, above by the second cervical vertebra, and below by the level of the last rib.

* Billard, at Brest, has performed gastrotomy to raise a xyphoid cartilage which was broken and pressed down to the stomach, the functions of which were deranged by it.

It is unmated and symmetrical, elongated and curved so that it is convex posteriorly and concave anteriorly; it is particularly thick in the centre, where it is measured by the distance from the summit of the spinous processes to the anterior part of the bodies of the vertebræ.

The dorsal region presents two faces, one on which the median septum of the chest rests; we shall speak of it hereafter: the other is cutaneous, and presents on the median line, a raphe, which is depressed in strong and well formed individuals, but is prominent in those of an opposite character: laterally, two longitudinal prominences, which belong to the sacrospinales muscles.

Structure.—1. *Elements.* The skeleton in this place is formed essentially by the thoracic portion of the spine: the vertebral articulations of the ribs are also situated there. Let us remember that the layers of the vertebræ are placed upon one another, and entirely cover the yellow ligaments: that the vertebral canal is narrow and cylindrical, that it contains the medulla which terminates at its lower part, and finally, that besides the curve convex posteriorly, presented by the spine, it is also slightly bent to the left; the dorsal portion of the sacrospinalis muscle, which occupies each side of this region, is composed of a small portion of the sacro-lumbalis, longissimus dorsi, transversalis colli, the lombo-dorsal interspinales, and the semi-spinalis dorsi muscles. The small supracostales muscles come from this region, where also we find the vertebral origins of the splenius, the two complexi, the serratus posticus minor, the rhomboideus, the trapezius, and the longissimus dorsi muscles. The vertebral aponeurosis or the small serrati muscles, belong solely to this part of the body; we must mention also its resistance and its attachments to the spinous processes on the inside, to the angle of the ribs on the outside, and its continuity above and below with the two serrati muscles: the skin is thicker than on the anterior face of the chest, but resembles it in the size and abundance of its follicles. The arteries come from the dorsal branches of the intercostal arteries, which belong exclusively to this region and proceed in it from before backward: we also find superiorly some branches of the deep cervical artery, and others on the outside, which come from the transverse cervical or the posterior scapular artery, the trunk of which is situated in the scapular region. The veins attend the arteries.* The superficial lymphatic vessels go partly to the axillary and partly to the cervical ganglions: the deep lymphatic vessels generally have a different destination, and terminate in the intercostal

* Godman has described as the *vena azygos dorsalis*, a small superficial vein situated on the median line, single at the base of the back where it arises, and separated above into two branches, which pass through the trapezius and go to the transverse cervical vein. This vessel is very constant.

ganglions. The nerves belong to the posterior branches of the dorsal nerves: they follow the course of the arteries: some of them also come from the cervical plexus and from the spinal nerve. The sub-cutaneous cellular tissue is very dense, especially on the median line; but the layer it forms cannot be called the dorsal aponeurosis. We find but little fat on the outside, and little or none between the muscles.

2. *Relations.* The relations of the dorsal region are very simple: we find there a first layer formed by the skin adhering on the median line to the summit of the dorsal spinous processes, which are covered with the supra-spinal ligament; then successively, on each side, we find a dense adipose cellular layer, in which the dorsal azygos vein of Godman is situated, the trapezius, and the latissimus dorsi, which the first covers in one point only, the rhomboideus, the serratus posticus inferior, and the vertebral aponeurosis; the splenius only above, but in every other part, the sacro-lumbalis, the longissimus dorsi, and the dorsal interspinales muscles, which are separated by two interstices, through which emerge the branches of the nerves and vessels which are distributed in the more superficial layers; above, and also on the preceding plane, we find the two complexi and the transversarius, which are situated a little deeper than this on the outside; finally, the supracostal and the semi-spinalis dorsi muscles, the costo-transverse articulations, then the inferior costo-transverse ligaments are exposed, and also the foramen formed by them with the spine, through which pass the dorsal nerves and vessels; finally, we perceive the layers of the vertebræ.

Development. The development of this region, by two primitively distinct lateral portions, is proved by the raphe: in the fetus, the back presents at first a posterior curve, which is much larger than in the adult: the lateral curve is deficient, the yellow ligaments are not completely concealed by the vertebral laminæ: after birth, the lateral curve is progressively formed, the spine becomes straighter, and the yellow ligaments are concealed, as we have seen. In the old man, the region resumes the characters of the fetal state, especially in respect to the curves.

Varieties. In some individuals, the posterior curve of this region is very great: this is true, also, of the lateral curve, in individuals whose professions require constant efforts of the right upper extremity, especially to raise weights. This curve, which is generally convex to the left, occurs in the opposite direction in left-handed people. Beclard has availed himself of this fact, to support Bichat's opinion, tending to show the lateral inclination of the spine as resulting from its necessary flexion when we raise a weight with one arm. This flexion takes place towards the side opposite the limb in action.

Farther, the absence of the curve in children, its disappearance in old men, its slight development in idlers, its great development in porters, are circumstances, which, with the facts admitted by Beclard, leave no doubt in regard to the mechanism of its formation.

Pathological and operative deductions. An arrest of development is followed sometimes with a complete, and sometimes with a partial division of this region, as in spina bifida: our remarks on lateral curvature explain why, in persons affected with rachitis, the dorsal curve is most generally an effect of the normal lateral curve: more rarely, it results from an increase of the posterior curve. On the contrary, in tabes dorsalis, which acts upon the skeleton of this region, and which consists in a tuberculous change of the bodies of the vertebræ, the flexion which constitutes a dorsal curve is from behind forward. In falls on the back, the spinous processes, or their layers, are fractured by a counterblow much more easily, as the first are sub-cutaneous, and as the region, on account of its curve, falls more on the soil than the rest of the posterior face of the trunk: we will remark, however, that the imbricated arrangement of the spinous processes protects them from the action of external violence, as does also the posterior curve of the ribs, which passes beyond their plane, and which, in falls, consequently comes first to the ground. Wounds of this region cannot cause a dangerous hemorrhage: a sharp instrument is less liable to injure the medulla in the adult than in the child: when it penetrates deeply in the adult, it is difficult to touch the medulla until it has passed through the layers of the vertebræ; in the second, their slight degree of imbrication produces an opposite effect. Some purulent tumors often appear in this region: if the pus be formed under the skin, it never points between the muscles, on account of the compact nature of the cellular tissue of this part; it tends very much to go downward, especially if it be placed under the vertebral aponeurosis, which prevents it from going towards the skin: hence the precept, to open deep abscesses early, if they are not caused by caries of the spine, and the slight inconvenience in waiting for superficial abscesses. Tumors formed by the development of the internal organs may raise the layers of the dorsal region: we shall speak of them separately.

4. DIAPHRAGMATIC REGION.

The inferior wall of the chest is situated deeply from the skin: it forms one great region, termed the *diaphragmatic.*

The diaphragmatic region is not complicated, but very important: its extent cannot be determined externally: it is included, as it were,

in the area of the base of the thorax, which serves as its limits : but it rises a certain height on the inside of it, which arrangement diminishes the cavity of the chest, and increases that of the belly. The thickness of this region is uniform in every part, and is about four lines; it descends lower posteriorly and on the sides, than anteriorly; its direction, also, is oblique downward, forward, and a little to the right, like the base of the thorax, which receives it.

In this region, we distinguish two faces and a circumference ; the upper face, which is serous and convex, looks backward, upward, and on the sides, thus establishing its relations with the dorsal, lumbar, and costal regions, from which it is separated only by a sinuous prolongation of each pulmonary cavity, into which prolongation the lungs penetrate during inspiration. In the centre, this face is united to the mediastinum and the pericardium, and its most convex part ascends to the level of the eighth dorsal vertebra : on the sides, it is loose, and some lines higher, on account of the general direction of the region, a direction imparted, particularly on the right, by that of its bony circle, and also by the liver, which presses it on this side. The lower serous face, also, which is concave, looks forward, downward, and inward : it is attached to the liver and stomach by cellular substance, or serous folds. The circumference is very much elevated anteriorly ; it is united to the sternal region near its lower extremity, and forms with it a triangular space, through which the cellular tissue of the mediastinum communicates with that of the abdominal wall at the pit of the stomach : it adheres to the costal region on the sides, where this circumference descends on the inside to near the level of the cartilaginous edge of the false ribs : finally, at the posterior part, it descends still lower, before the upper part of the lumbar region, with which it is united, and forms, first, an oblique median opening, the aortic passage, through which the aorta, the thoracic canal, and the azygos vein pass : second, two other lateral openings, surrounded by fibrous arches ; one of these encloses the upper extremity of the psoas, the two tri-splanchnic nerves, and the great sympathetic nerve ; the other contains the last intercostal vessels and nerves. Through this region, the vena cava and the esophagus pass : for the former, there is a quadrilateral fibrous opening ; and for the second, an opening which is fibrous above, and fleshy below and on the sides.

Structure.—1. *Elements.* This region is formed essentially by the diaphragm, which is tendinous in the centre, and fleshy at the circumference, to which the two pleuræ and the serous layer of the pericardium contribute above, and the peritoneum below, and also a compact cellular tissue, free from fat. The arteries come from the internal mammary artery and the aorta, by the superior and inferior

diaphragmatic arteries: some also come from the last intercostal arteries: the veins and the lymphatic vessels follow the same direction. The nerves are twigs of the cerebro-spinal system, and are particularly, the two phrenic nerves, branches of the cervical plexus, and some filaments of the last intercostal nerves. Some branches proceed, also, from the great sympathetic nerve, by means of the inferior diaphragmatic plexuses, the smallest divisions of the solar plexus.

2. *Relations.* The special relations are extremely simple, and need hardly be mentioned: on the sides, the pleura, the fleshy portion of the diaphragm, and the peritoneum: in the centre, the serous membrane of the pericardium, the tendinous portion of the diaphragm, and the peritoneum.

Development. The sides of this region are doubtless formed first, and it is completed by their union in the centre: it is said, that at first, it does not exist, and that then the abdomen and thorax are united, and form one great splanchnic cavity, similar to that of birds, reptiles, and fishes.

Varieties. This region is a little more convex in the female than in the male; and more so in those who have borne many children.

Uses. The resistance of the diaphragmatic region is very great in the centre, on account of its aponeurotic structure, and because its fibres interlace there in every direction; ruptures of it occur solely on the sides, where the fleshy fasciculi are loose and easily separated. The whole of this region executes motions, by which its directions and positions are singularly varied. These motions are greatest in the sides, the centre being kept in place by its median adhesion: sometimes the entire region is depressed, and sometimes elevated, as in respiration; sometimes its surface is diminished by the contraction of its osseo-cartilaginous frame. When this is depressed quickly, it imparts to the abdominal viscera an impulse, which extends to the right buttock if the anterior abdominal wall be relaxed; but this latter receives the impulse, when it is contracted spasmodically, as in vomiting; then, in fact, the anterior abdominal wall forms a plane turned backward and upward, opposite in every respect to that of the diaphragm, and the stomach is pressed violently between the two regions.

Pathological and operative deductions. This region may be partially or entirely deficient: we have seen a fetus in whom only the cardiac region existed. Before arriving at this region a wounding instrument must first pass through the costal, lumbar, dorsal, or costo-iliac regions; the diaphragmatic region can be affected only by blows, which act obliquely on the latter, from below upward. Farther, in a pregnant woman, during a full expiration, a wounding instrument, carried horizontally very high on the costal region, may reach the lower

wall of the chest, which in opposite circumstances being very much depressed, might be uninjured by the same instrument. We will say also, that an instrument which touches this region, if it acts on the mathematical line represented by its circumference, must penetrate into the abdomen or the chest; it might even be introduced into both, either first passing into the former cavity, or, on the contrary, acting primarily on the second. In violent exertions, or in falls from a lofty place, the diaphragmatic region is sometimes lacerated on the right or left, more frequently on the left, doubtless because this side is less supported: hence the hernias termed diaphragmatic, in which the floating viscera of the abdomen go upward into the thorax: this occurs more easily, because in inspiration the diaphragmatic region is depressed towards them. We saw in the Hospital la Charité, in 1820, a strangulated diaphragmatic hernia of the stomach. Diaphragmatic hernias may also occur through the infrasternal space. They may be fatty. In ulcerations by a pulpy softening of the stomach, termed spontaneous ulcerations, this region is sometimes perforated entirely; we have seen several instances of this, and it has been said in these cases, that a corrosive liquid from the stomach had acted upon it. When speaking of the costal region, we mentioned the sympathy between this and the diaphragmatic region. When the pleura or the diaphragmatic peritoneum are inflamed, severe pains are felt, and extend towards the neck and the top of the shoulder; the diaphragmatic nerve, the origin and termination of which correspond to these points, explains this phenomenon. Most physicians consider inflammation of the diaphragm as constantly manifested externally by the Sardonic laugh; this affection always affects respiration in a great degree, as the diaphragm is the principal agent of it. Farther, in inflammations of the region of the diaphragm, the base of the chest is selected for the application of leeches and for counterirritation, where the intercostal vessels and nerves ramify partly in the skin, and send some filaments also towards the circumference of the diaphragm. We shall not mention here those cartilaginous or osseous diaphragms found by authors: they have mistaken as such incrustations of the pleura, or peritoneum, whether situated in its loose surface or formed on the attached portion of these membranes.

5. UPPER WALL OF THE THORAX.

This wall, situated at the union of the thorax and tracheal portion of the neck, corresponds in the centre to the laryngo-tracheal region, and on the sides to the supra-clavicular and carotid regions. The most general remarks are, that it is constituted by all the organs which

are comprehended in the area of a circle, formed by the sternum anteriorly, the spine posteriorly, by the first rib and its cartilage laterally and on each side. It would be useless to enter into farther details, which would expose us to repetitions; we should also anticipate our remarks in respect to the mediastinum and the pulmonary cavities.

We observe, however, in conclusion, the providence of nature in arranging the upper part of the thorax: she has rendered its circumference immoveable by forming it of bones; and hence, by freeing the important organs which it contains from all compression, she has insured the integrity of their functions.

ARTICLE II.

CAVITY OF THE CHEST.

The cavity of the chest is not single, although it is generally mentioned as such, but it presents this arrangement only in the skeleton. In the recent state, this portion of the trunk is divided into two distinct cavities, in which are situated the lungs; hence these cavities are called the pulmonary cavities. We have studied the different regions which form the external circumference of the chest; we have now to examine that which separates them, the mediastinum. We shall then study the pulmonary cavities.

PARAGRAPH FIRST.

MEDIASTINAL REGION.

This region is not visible externally; its limits are nevertheless exact; it is continued to the skin by the sternal region anteriorly, by the dorsal region posteriorly, and it terminates below in the inferior wall of the thorax, and above near the superior.

The direction of the mediastinum is oblique downward, and to the left; to observe it, we must examine this region only in the centre of its faces, and especially on the left. Its direction, posteriorly and anteriorly, directly under the sternum, is that of the median line. This consideration is highly important, as we shall see hereafter.

The height of the mediastinum varies; its antero-posterior diameter is equal to the distance from the sternum to the spine; its breadth is considerable below and also above; in the centre, this region is narrower than in any other part; hence it has been compared to an X.

This region presents two smooth lateral faces, and gives insertion, at the root of the lung, to the union of their posterior third with the two anterior thirds. The left face is convex downward and in the centre, it also varies a little from this side; the right face is concave in the same point.

Structure.—1. *Elements.* Most of the organs of the mediastinum only pass through it, and others terminate in it, but do not arise there; finally, others arise in it and go elsewhere; very few belong entirely to this region; the principal elements of this region are the heart and its envelope, the vessels which come to it, those which depart from it, the esophagœal portion of the alimentary canal, the termination of the trachea and the origin of the bronchi, the vena azygos, the thoracic canal and many lymphatic ganglions which receive the lymphatic vessels from the organs of this point, the par vagum and the cardiac nerves, the thoracic portion of the tri-splanchnic nerve, the superior diaphragmatic nerves and vessels, with a layer of each pleura: we also find in it a very loose cellular and adipose tissue, some mediastinal vessels, and some others which belong to the different organs mentioned, especially to the bronchi, the esophagus, the pericardium, and the aorta.

2. *Relations.* The relations examined from before backward are very complex, on account of the great number of the organs; hence to study them we shall divide the mediastinum into two portions, the cardiac and the supra-cardiac.

In the cardiac, the following layers successively appear behind the lower half of the sternal region; first, a loose cellular and adipose layer; second, the anterior part of the pericardium;* third, the heart, from which the large arteries arise, and in which the vena cava terminates; if we analyze the elements of this layer more particularly, we find there; anteriorly, the right ventricle, the pulmonary artery, the right auricle; more deeply, the oblique septum of the ventricles; still more deeply, the left ventricle, the aorta which conceals the pulmonary artery, the left auricular appendix, the right auricle, and the superior vena cava; finally, the left auricle and its veins. These are the parts in the pericardium through which an instrument would pass,

* On account of the convexity of the left lateral face of the mediastinum, which is crowded back by the heart, the left pleura slightly covers the pericardium anteriorly, and this is thus connected with the left costal region.

if introduced directly from before backward, and this also is the order in which the parts would be injured: fourth, in this cardiac portion of the mediastinum, but more deeply, the posterior part of the pericardium; fifth, many ganglions, the esophagus, situated on the median line, having on its edges the esophagœal cords of the pneumo-gastric nerves; sixth, the aorta on the left, the azygos vein on the right, the thoracic canal in the centre; seventh, a loose cellulo-fatty layer, in which the splanchnic nerves, the intercostal arteries and veins, ramify; eighth, the spine.

In the supra-cardiac, behind the upper half of the sternal region, we find successively from before backward; first, a loose cellulo-fatty layer, in which some ramuscules of the internal mammary artery are situated; second, below, a prolongation of the pericardium, superiorly, the left subclavian vein, which is directed obliquely downward and to the right; third, a plane which first looks forward, then inclines to the right and left to turn around the bronchi, and is formed in its first portion by the aorta, the brachio-cephalic trunk, and the superior vena cava; the left oblique portion of this plane is formed by the end of the pulmonary artery, the arterial ligament, by the arch of the aorta which turns below and behind the recurrent nerve, by the left subclavian and carotid arteries, on the outside of which glide the left par vagum and phrenic nerves, which are at first contiguous but are then separated inferiorly; finally, the right oblique portion of this layer is formed by the terminating curve of the azygos vein, which resembles the arch of the aorta in many respects; on the outside of this curve, the par vagum and phrenic nerves glide, as on the left: fourth, we find above and on the median line, the end of the trachea, on the left of which is situated the left recurrent nerve; below, a rhomboid, circumscribed by the bronchi and the two branches of the pulmonary artery and filled with lymphatic ganglions; fifth, the esophagus, which curves to the left and is situated behind the left bronchus; sixth, the aorta, the azygos vein, and the thoracic canal between them; seventh, a loose cellular tissue, in which the superior intercostal vessels and some filaments of the trisplanchnic nerve ramify; eighth, the end of the longus colli muscles; ninth, the spine. The loose and abundant cellular tissue, which connects all the organs of the mediastinum, communicates very readily above with that of the neck, under the cervical aponeurosis, and below with that of the abdomen, in two points: first, before the vertebral column, through the aortic opening; second, anteriorly, through the substernal triangular space of the diaphragmatic region.

Before arriving at all these organs, in penetrating through the lateral face of the mediastinum, we come to the pleura, which is intimately united to them inferiorly by a cellular tissue, in which are

found; the diaphragmatic vessels and nerves, which are a little longer on the left on account of the convexity of this face of the mediastinum, to which they are near; these vessels and nerves are directed obliquely downward and backward, and consequently are superficial at the upper part and deep seated at the lower; they are deeper on the left than on the right, and pass before the root of the lung which separates them from the par vagum. The root of the lung leaves the mediastinum nearer its upper and posterior edges, than those which are opposite; it is formed from before backward; first, by the pulmonary veins; second, by the pulmonary artery; third, by the bronchus, surrounded by lymphatic vessels and ganglions, having before it the anterior pulmonary plexus, formed by some filaments of the pneumogastric nerve and of the cardiac plexus, and behind it, the par vagum nerve and the posterior pulmonary plexus. Finally, we remark, that the root of the lung separates on each side the phrenic and par vagum nerves, and it serves, in its narrow portion, for the limits of the anterior and posterior mediastina of authors; a division which is objectionable, because it cannot be traced with exactness.

Development. The mediastinum presents at first in the fetus no lateral deviation, the heart itself being situated entirely on the median line; its deviation does not appear until the third month of fetal existence; in the early periods, and even after birth, the mediastinum contains the thymus gland, which forms its first layer under the sternal region; this layer is at first general, but afterwards retreats to its upper part. This organ is entirely wasted after birth; and in the adult, its place, as we have seen, is occupied only by a cellulo-adipose layer; there is no fat in this region in the fetus, and but little in the child; a moderate quantity of it in the adult, while it exists in great quantity in old age.

Varieties. The mediastinum is convex on the right, where the viscera are transposed, or even where there is a mal-position of the heart. In the first case, all the organs of the mediastinum, which are usually found on the left side, are situated on the right, and *vice versa.* Sometimes supernumerary arteries leave this region, on the plane of the arch of the aorta, and go to the neck; they are the inferior thyroid or the vertebral artery. The numerous varieties of the aorta and the arteries which come from it, so well described by Meckel and Tiedemann, present no modification in the relations of this region; some, however, are exceptions to this. We shall mention particularly the alternate bifurcation and union of the aorta, which thus circumscribes by its branches a circle, in which the trachea and esophagus are situated; and another variety, in which the aorta divides near its origin into two branches, each of which, as in reptiles, turns around the cor-

responding bronchus in the form of an arch, and then unite behind the heart in a single trunk. The mediastinum is lower in females; its height also is considerably diminished during pregnancy.

Pathological and operative deductions. It has been said that this region may be entirely deficient. Cruveilhier has seen a fetus, where one of its pleural layers, the left, did not exist; the heart was loose in its corresponding pulmonary cavity. Breschet has mentioned a similar case in the first number of his *Repertoire d'Anatomie Pathologique.* In those cases where the sternal region is divided, that of the mediastinum is exposed; the same result is produced artificially by the removal of a portion of the sternum. Wounds of this region are serious, as may be seen from the important functions of the parts contained in it; it is so filled with vascular organs, that its lesions are generally fatal, from the hemorrhage they cause. A wounding instrument, which acts horizontally from before backward, cannot reach the mediastinum, until after passing through the sternal region, except on the left side and inferiorly, where the mediastinum is in relation with the costal region, which must previously be perforated below: the relations mentioned demonstrate sufficiently that if the instruments have not penetrated deeply, the pericardium alone may be opened, or with it the right cavities of the heart and the pulmonary artery, while more deeply the left cavities and the aorta may be interested: the parietes of the ventricles are so thick that they may be wounded, although their cavity is not opened, as has been observed. The left cavities of the heart, and the other organs which are situated deeply in the mediastinum, may be injured at first, if the wounding instrument acts from without inward; the wound must be very deep to affect the esophagus. The left lateral prominence of the mediastinum, and particularly that of the heart and its envelope, has suggested to surgeons the idea of puncturing the pericardium when filled with serum. This operation was proposed by Senac, and performed by Desault. Senac advises to operate on the third intercostal space, two fingers' breadth from the sternum, directing the trocar obliquely downward. In this operation, we avoid injuring the internal mammary artery and its branches, but the pleura is opened. The heart, also, may be injured, and the patient immediately destroyed. Skieldrup and Laennec have proposed to trepan the sternum at the lower part, and to open the pericardium, when a liquid is felt in its cavity. The same mode is proper for opening superficial abscesses of the mediastinum, the pus from which, by continuing, might disunite the elements. Abscesses of the mediastinum have sometimes pointed at the abdominal wall, near the pit of the stomach, after dilating the substernal opening of the diaphragm. We have seen one case of this kind. These ab-

scesses may be formed by the pus coming from the cervical region; our remarks on this region demonstrate, however, that those which terminate in this manner are situated under the cervical aponeurosis. Caries of the bodies of the dorsal vertebræ may give rise to congested abscesses, which fuse under the aorta, in the very loose cellular tissue which surrounds it, and proceed into the abdomen through the aortic opening of the diaphragm. The bronchial or esophagœal ganglions frequently tumefy, and in most cases from sympathy; they then compress the esophagus, and cause dysphagia, or they flatten the trachea, and hinder respiration; or after producing these symptoms, they form abscesses, and open into the esophagus, into the left bronchus, or into both. The aorta may be affected with aneurisms at its origin, or at its descending portion; when developed in its ascending portion, they go particularly toward the sternum, which they destroy, in order to open externally: sometimes they open into the mediastinal region: these tumors compress the trachea posteriorly, into which they open, or they are developed laterally toward the lungs, which sometimes collapse when pressed against the ribs. The aneurisms which are formed at the arch of the aorta may also affect the sternal region, contract the esophagus and trachea, into which they sometimes open posteriorly: below, they act on the root of the left lung; above, they may be developed toward the neck. The recurrent nerve is generally very much compressed in aneurisms of the arch of the aorta, especially in those which are developed inferiorly and posteriorly; this fact has appeared sufficient to some writers, and particularly to Bourdon, to account for the aphonia which so often attends these tumors, which, however, is better explained by their compressing the trachea. Aneurisms of the mediastinal descending aorta, by being developed anteriorly, compress the esophagus, and crowd back the heart, so as to lead to the suspicion, as we have seen, of an affection of this organ; farther, this error is much more easy, inasmuch as double pulsations are felt by the patient much stronger and more superficial than usual. These tumors destroy the vertebral column on the left, and it is worthy of remark, that here, as in all other points, the bones yield much more promptly than the intervertebral fibro-cartilages; doubtless because these latter, from their elasticity, bend under the pulsations: finally, they also may, however, be destroyed. We have seen an individual affected with so large an aneurism of the descending thoracic aorta, and one of so long standing, that it had projected into the left pulmonary cavity, and crowded back the lung, had destroyed the posterior extremity of the ribs, and pulsated in the dorsal region, which was raised by it. From the influence of causes but slightly understood, the esophagus sometimes undergoes a change, which is at first pulpy,

and afterwards it is completely destroyed; this seems of the same nature as the alteration of the stomach which precedes spontaneous perforations of this viscus. We have seen it twice in patients who died from other diseases; farther, in one of them, the esophagus was destroyed the whole length of the mediastinum, which represented an enormous sac, distended by the drinks swallowed by the patient before his death.

PULMONARY CAVITIES.

Each side of the thorax presents a cavity, termed the pulmonary, because it receives the lung. Its parietes are formed externally by the costal region: the sternal and dorsal regions, which are continuous with the mediastinum, separate these two cavities. The form of the pulmonary cavity is that of the lung, which it exactly contains. A body moulded upon it would be convex on the outside, flattened internally, and slightly concave below and to the left; it is rounded above, and received in a sort of cul-de-sac, which rises above the first rib; its lower part is concave in the centre, and would terminate on the outside by a very depressed cutting edge, and would be received in a narrow sinus, formed, as has been said, by the union of the costal and diaphragmatic parietes, the costo-diaphragmatic sinus. The vertical extent of this cavity generally varies, like the position of the diaphragmatic region in respiration; these variations, however, occur only in the centre; near the ribs, the cavity is always bounded below by the invariable attachments of the diaphragm, on which the pleura is reflected. The vertical diameter is less on the right than on the left side; the transverse diameter presents an opposite arrangement; on the left, it is more extensive posteriorly than anteriorly, on account of the lateral curve of the spine and the deviation of the mediastinum; on the right, we find an opposite arrangement, for opposite reasons; generally considered, the right pulmonary cavity is larger than the left in the normal state. The lungs, which are contained in the pulmonary cavities, must not be described here; they belong to descriptive anatomy. We will only remark, that they are united by their roots with a determinate point of the mediastinal face of their cavities, near which the pleura is reflected upon them.

Development. The pulmonary cavity is but slightly developed before birth, as the lung within it is compressed transversely, and is not convex posteriorly, as in the adult: at sixteen years of age, the posterior processes of the ribs are developed, and extend the pulmonary cavity on this side, which at the same time passes beyond the plane of the spine.

Varieties. The pulmonary cavities present numerous individual varieties: in the female who is pregnant, and during expiration, they are much smaller than in the opposite case, where their costo-diaphragmatic sinus is very much enlarged.

Pathological and operative deductions. In acephalous fetuses, the two pulmonary cavities are deficient; the lungs are not formed, most of the median thoracic organs do not exist, and when the region of the ribs is seen, we find below it only cellular tissue infiltrated with serum. The adhesion which always supervenes accidentally between two contiguous layers of the serous membrane, often completely or partially closes this cavity. If we do not describe here the different forms of these adhesions, nor their formation nor organization, these circumstances should be carefully noted, because they modify the prognosis of penetrating wounds of this region, which thus become nearly as slight as those which are not penetrating: in fact, when the adhesions have closed the pulmonary cavity, neither pleurisy, nor internal effusion, nor hernia of the lung, is to be feared; hemorrhage can be easily stopped by compression, and if emphysema supervenes, it may be removed by a free incision. The old cartilaginous or osseous adhesions, compensating for the inconvenience they cause by their firm protection, sometimes form a kind of internal shield, capable of arresting wounding instruments, and prevent them from producing wounds which would otherwise be fatal. In the usual state, wounding instruments, which are sometimes, but rarely, arrested in their course by the ribs, open the pulmonary cavity, and then injure the lung. This organ extends to every part in inspiration, but in expiration it leaves the costo-diaphragmatic sinus, and consequently it cannot then be wounded in this part.

The inevitable result of the simplest penetrating wound of the thorax, is the immediate entrance of air into the cavity, the crowding back of the lung, which is then separated from the ribs by a certain space, and more or less hinders respiration, and the discharge during expiration of a portion of gas introduced in inspiration. If the wound be narrow, these phenomena are very much marked, and the alternate entrance and expulsion of the air from the wound, are attended with a loud rustling, resulting from the vibration of its lips: if its course be oblique, the air enters the adjacent cellular tissue, and produces the first kind of emphysema: the second exists when the lung itself is injured: the air which emerges, passes from this organ into the pleura, then into the external cellular tissue through the wound: this second kind of emphysema supervenes, also, without an external wound, when the fragments of a fractured rib have been pushed toward the lung. When there is a penetrating wound of any size, but little or no em-

physema exists ; hence, it is for this reason, that narrow wounds, with this complication, are enlarged, or that we cut upon a fracture of the ribs attended with emphysema : when the ribs are broken, this operation is also performed for the double purpose of removing the infiltration of air, and of raising the fragments which irritate the lung. The effusions which occur in one of the pulmonary cavities, press the lung, and cause it to collapse against the mediastinum, which they also depress sometimes, so as to contract the opposite cavity very much, and to remove the heart from its normal position : hence, the respiration is still more obstructed ; hence, also, the error of many, who think that congenital transpositions of the heart, or dilatations of this organ exist, which are not seen in post mortem examinations. When pus is formed in the chest, the wall of the diaphragm is crowded towards the abdomen, the costo-diaphragmatic sinus is very much enlarged, the ribs are thrown outward and are immoveable : the lung often forms adhesions in its forced position, and then, if the patient is cured, the depression of the costal region, already mentioned, supervenes. Valentine asserts, that in effusions of blood, this fluid, after descending to the lower part of the pulmonary cavity, passes into the cellular tissue, and an echymosis appears in the loins. This infiltration, which cannot take place except the blood has transuded through the pleura, is not constant. This is not the place for mentioning the different modes of examining the chest, but we must remark that these results vary according to the points examined ; this should be remembered : at the upper part, the walls of the chest, as we have stated, are enlarged by the thickness of the shoulder, and auscultation and percussion are there difficult : at the lower part, the relations between the chest and the abdomen are such, that in employing the modes of investigation, it must be made on both sides : thus, for instance, the chest, when struck at the lower part of the left side, resounds moderately if the stomach be empty, but very much, on the contrary, if this viscus be distended with gas ; the sound is very dull if the stomach be filled with food : thus, although percussion may be used here for the chest, it also shows the state of the abdominal viscera ; so, likewise, on the right, by percussion at the lower part, we ascertain the state of the pulmonary cavity and of the liver. The centre of the sides of the chest is the most proper point for using the method of exploration ; because they are thinner than above, and also because we become acquainted only with the state of the thorax. Percussion, also, when applied anteriorly and posteriorly, makes us acquainted with the mediastinum and its organs.

CHAPTER III.

OF THE ABDOMEN.

The abdomen, derived from the Latin word *abdere, to conceal*, the belly, &c. &c., comprises all that part of the trunk which contains, in the mammalia,* most of the alimentary canal, the urinary and the genital organs, and which supports the inferior or posterior limbs, when they exist. The abdomen has very distinct limits: it is continuous with the chest above, and is distinguished from it by a curved line, concave upward, which is very elevated anteriorly, but less so posteriorly: this is the prominence of the cartilaginous edge of the last ribs: these external limits, however, are not those of the abdominal cavity. The first section of the abdominal limbs, the haunch, belongs in the inside to this important part of the trunk. The abdomen is situated mostly above the centre of the body. Its form is elongated: it is slightly oval, and differs in the sexes: its direction is generally that of a curve, concave posteriorly: its size varies, as will be stated below.

If we consider its exterior only, the abdomen seems separated, very symmetrically, into two parts, by the median line; but this is not the case internally. In no part is the raphe more distinct than in this.

Structure. The skeleton of this region is the lumbar portion of the spine and the pelvis; these parts, with the base of the chest, form a vast fissure open anteriorly; it is also composed of muscles of different characters, vessels, and nerves.

Development. The abdomen is the first part of the body formed on the umbilical vesicle, with which it is united: they are soon separated, however, by a short pedicle, the rudiment of the umbilical cord. This cord then extends rapidly, so that at birth, it equals the length of the child: at first it proceeds from the lower part of the body, and then its position, in proportion to the entire body, is more and more elevated. During the whole of fetal existence, and even after birth, the abdomen retains marks of its premature appearance: its size, considered proportionally to that of the other parts of the body, is greater than in the adult. In

* In the other vertebral animals, the diaphragm is deficient, the abdomen and chest are united, and form only one large splanchnic cavity.

the young child, the abdominal fat is all external, and seems to retreat internally as age advances: however, at forty-five or fifty years of age, the sub-cutaneous fat of the abdomen often reappears. The first development in respect to the separate pieces which primitively form the abdomen, and the manner in which its pieces are approximated, differs in no respect from that of the trunk.

Varieties. In the female, the abdomen is larger than in the male; it is proportionally higher also: the large extremity of the oval which it represents looks downward, the opposite is true in the male. The abdomen presents numerous individual varieties, especially in respect to size.

Finally, the external form of the abdomen constantly changes: it tumefies after eating, during inspiration, and collapses under opposite circumstances. Its direction also changes in different attitudes. During pregnancy, it is distended in every part, especially anteriorly.

Uses. The abdominal part contains most of the alimentary canal, the urinary and genital organs: it protects them all, and facilitates their action by its motions. Its muscles frequently contract for purposes disconnected with the abdomen, for respiration or for the general motions of the body; these considerations must be kept in view, in order to form our opinions of the numerous diseases of the abdomen, particularly of hernias. The early development of the abdomen, and especially its primary formation, implies that it cannot be entirely absent, even in the greatest monstrosities; it may be called the *root* of the individual, and when this root is deficient, the individual cannot form even irregularly. In the abdomen we must examine the cavity and its parietes; we will commence with the latter.

ARTICLE I.

ABDOMINAL PARIETES.

The circumference of the abdomen is generally divided into anterior, posterior, lateral, superior, and inferior parietes. This division, which is generally good, cannot be admitted in topographical anatomy as the base of the abdominal regions, because it is not always founded

on exact limits, or differences of structure; thus, for instance, the anterior and lateral walls are uniform in every part, they have the same structure; it would therefore be inconvenient to separate their description, and further to subdivide them artificially into secondary regions: this would render us liable to repetitions, and would obscure a subject which is naturally clear.

Although the abdominal parietes are very different in every respect, they have also some analogies, on which we must dwell for a moment: all have two faces; one is internal and serous; the other is external, and is generally covered with skin; the upper wall is the only exception to this. They are provided with many aponeuroses, and these form openings for the vessels. These openings are frequently only the commencement of the canals or passages which pass obliquely through the parietes of the abdomen: they contain with the vessels a very loose cellular tissue, with some pieces of fat, and are closed on the inside by the serous membrane of the abdomen.

Uses. The parietes of the abdomen are contractile, and often act in this manner: they resist, on account of their compact structure. Here we remark, that nature has formed the aponeurosis distinct from the muscles, in those parts against which the viscera press most frequently, and there also they are more resisting: they are very strong and numerous at the base of the anterior wall, and particularly in the inferior; this latter arrangement is very remarkable in the human species; the first, on the contrary, in the great quadrupeds: these facts from human and comparative anatomy would establish, if necessary, that man was formed for the erect and other animals for the horizontal posture.

Pathological and operative deductions. The openings or the vascular canals of the abdominal parietes, are the parts through which the viscera in most cases pass and form hernias: the looseness of the cellular tissue which closes these passages predisposes to these affections: but in return, their oblique direction, which is similar to that of the ureters through the walls of the bladder, is a precaution taken by nature to prevent them. The adipose substance which they contain when the person becomes very fat, at first dilates the opening, and then destroys its elasticity; and if in these cases, the person loses his flesh, these elastic portions rapidly disappear, and hernias are easily produced. Finally, the fat of the abdominal openings, when very abundant, may be developed on the outside, and by its weight may draw downward the part of the peritoneum which covers the opening on the inside, and thus cause the formation of a true sac, which requires only a few folds of intestine, to constitute a complete hernia, called a fatty hernia.

PARAGRAPH FIRST.

ANTERIOR AND LATERAL ABDOMINAL PARIETES.

These portions of the circumference of the abdominal cavity are continuous: they are similar in respect to the absence of an osseous portion which serves as a point of support: they are formed in almost every part by the same layers. From these considerations they should be blended in one region, which Beclard proposed to call the costo-iliac region, from the name of the two parts of the skeleton between which it is included.

ANTERIOR AND LATERAL ABDOMINAL (COSTO-ILIAC) REGION.

The form of this region, when detached and extended upon a plane, is that of the Maltese cross; it presents two lateral prolongations, which enter between the iliac crest and the false ribs; and two others, one superior, extending into the substernal fissure of the base of the thorax; the other into that of the superior edge of the pelvis anteriorly. Its limits are well defined: above, the thorax, the base of which projects externally; below, the pelvis; on the outside, the prominence of the external edge of the sacro-spinalis muscle. Its thickness varies; upon the median line, it is four lines; at the rectus muscle, it is ten lines; on the outside of this muscle, from six to eight lines. Generally, this region is thicker below than above.

It presents two faces; one cutaneous, the other peritoneal. The first presents on the median line a raphe, which is very distinct and situated at the base of a variable depression; in the centre, the umbilical cicatrix; above, a triangular cavity, the substernal fossa, the *pit of the stomach;* below, some hairs continuous with those of the pubis; upon the sides of the median raphe, a prominence which is broader and as it were expanded above, belonging to the rectus muscle; entirely on the outside, a surface concave from above downward, convex transversely. Finally, in fat individuals, this face slightly projects above the level of the haunch and the groin. The second is smooth, and generally concave, except when contracted; we find there, the posterior face of the umbilicus, whence proceed, superiorly on the right, the cord formed by the obliteration of the umbilical vein, and its falciform peritoneal fold, while downward, descend the two umbilical arteries and the obliterated urachus, then their peritoneal folds, which diverge and form a triangle, the base of which is inferior. The um-

bilical arteries cause two peritoneal fossæ, which vary in their position; they are of little importance, and are termed the inguinal fossæ.

Structure. — 1. *Elements.* Properly speaking, the costo-iliac region has no skeleton, although Meckel considers the linea alba and the tendinous intersections of the rectus muscle, as representing the sternum and the ribs. Several muscles belong to it; the recti and pyramidales muscles on the median line, the latissimus dorsi posteriorly, the two obliqui and the transversalis on the sides; their description does not belong to topographical anatomy; we will only mention that the inferior edge of the obliquus externus muscle, by folding from below upward and from before backward, forms Gimbernat's ligament,* and is continuous with the *fascia transversalis* and *the fascia iliaca*, as we shall mention when describing the groin; this fold forms the crural arch, the Fallopian or Poupart's ligament, an arch, the direction of which is oblique downward and inward; and this is attached to the superior and anterior spine of the ilium, on the pubis, and measures by its length the space between these two points. The crural arch adheres to the ilium in only one place; it separates, on the contrary, on the pubis, into two fasciculi; one, the external pillar of the ring, is inferior, and is attached to the spine of the pubis; the internal pillar of the ring is superior, and terminates before the symphysis, crossing with that of the opposite side. Between these pillars is an oblique opening, the inguinal ring, the base of which rests on the pubis, while its upper side corresponds to the point of separation of the two pillars, and is formed by some fibres which interlace perpendicularly to the direction of the pillars. The aponeurosis of the obliquus externus muscle, by reflecting in this manner, forms a groove or channel open above, on the external third of which the obliquus internus and transversalis muscles are attached together, while their lower edge is fleshy, and has a horizontal direction, differing in this respect from that of the obliquus externus muscle; from this opposite arrangement it follows that the obliquus internus and the transversalis muscles on the inside, are not contiguous to the aponeurosis of the obliquus externus, in a triangular space which corresponds, as we shall see, to the posterior wall of the inguinal canal; the three muscles of the abdominal wall of which we are speaking are aponeurotic internally and anteriorly, and form a sheath for the recti and pyramidales muscles, which is perfect anteriorly, imperfect posteriorly; on the median line, they unite with each other, and with those of the opposite sides, in a tendinous raphe, which constitutes the *linea alba.*† Considered as a special part, this line is attached

* We shall treat more fully of this ligament hereafter.

† Some include under this term, all the space comprehended between the two recti muscles.

above to the xyphoid appendix, below to the pubis. Its anterior and posterior faces are intimately united to the skin and peritoneum; we find there many openings, besides the umbilical ring. They give passage to vessels which proceed from the deep face of the abdominal wall, and go outward or vice versa; we sometimes find large masses of fat in the course of these vessels; the vascular openings of the linea alba are more numerous at the umbilicus and above it, than at any other part. The linea alba is more developed in the large animals, and is very elastic; it forms in them a large spring, which supports the abdominal viscera, and assists the action of the muscles. Two aponeuroses appear also in this region, and must be described minutely: they are stronger below and on the outside of the rectus muscle, than in any other part: there also, as we have already said, the obliquus internus and the transversalis muscles do not descend, and there the wall of the abdomen is strengthened in another manner. These aponeuroses are termed the superficial and the transverse fascia.

The superficial fascia of Camper is, in the male, a fibro-cellular layer, continuous above with the sub-cutaneous cellular tissue of the thorax, descending below into the testicular region, where it forms the dartos, and to the anterior part of the thigh, where it soon terminates in the sub-cutaneous tissue, and is also attached by one of its folds on the fascia lata, below the crural arch; it is attached on the outside to the iliac crest, and descending a little on the haunch, it is formed of several layers, between which the superficial vessels and the fat of the abdomen are situated. One of its faces rests on the obliquus externus muscle, on the haunch, the testicular region, and the thigh; the other is united to the skin. In the large animals, the superficial fascia, like the linea alba, is very much developed, and is extremely elastic.

The transverse fascia of Cooper, a reflected fold of the aponeurosis of the obliquus externus muscle, does not really exist, except in a triangular space, circumscribed by the external edge of the rectus muscle, the crural arch, and an imaginary line drawn horizontally from the anterior and superior spine of the ossa ilia, toward the rectus muscle; there only is it necessary to strengthen the abdominal wall, as we have seen. This aponeurosis is continuous on the inside with the external edge of the tendon of the rectus muscle, below, in all its extent, with the crural arch, and on the outside only, with the iliac fascia. By its anterior face it is separated below from the aponeurosis of the obliquus externus muscle by the inguinal canal; above, it rests on the transversalis muscle; posteriorly, it bounds the peritoneum and the epigastric artery. Two fingers' breadth on the inside of the iliac spine, or just above the crural arch, the transversalis fascia presents an elongated opening, the inside of which is falciform and very resisting, and the outer side of which is

very weak: this is the upper orifice of the inguinal canal. In this place, the aponeurosis is only apparently interrupted, it is depressed in the form of a funnel, and forms the common sheath of the testis and of its cord.

The skin of this part of the abdomen is very strong, and its areolæ are very distinct: it is very hairy near the pubis. The peritoneum presents nothing peculiar, except its folds, which we have already mentioned; its adhesion is more or less intimate, and is very firm on the median line.

The arteries arise in the centre from the substernal, the epigastric, and the sub-cutaneous abdominal arteries, on the outside from the last intercostal arteries, from the lumbar arteries which terminate there, and from the circumflex iliac, which is situated on the iliac boundary of the region. As a general rule, these external arteries become less deep as they approach the median line, and particularly the umbilicus. The veins follow the course of the arteries; the superficial are broad and numerous. The lymphatic vessels are deep or superficial: the first, are few in number, follow the arteries, and go to the iliac, lumbar, and substernal ganglions; among the second, those of the sub-umbilical portion converge toward the inguinal ganglions; those of the supra-umbilical portion terminate in the axillary ganglions. The nerves come from the last intercostal and lumbar pairs. The superficial cellular tissue is loose; the sub-peritoneal is more dense; on the median line it is very dense, superficially and deeply; the fat particularly is situated superficially. The spermatic cord, or the round ligament, pass outward, through the abdominal wall; but in the fetus, only the umbilical cord passes through it.

2. *Relations.* The relations of the costo-iliac region vary, according as they are considered on the median line, at the rectus muscle, and on the outside of it; we will examine them there in these different points. On the median line, we find successively, the skin, which is very adherent, depressed and hairy at the lower part, a thick layer of cellular tissue, the linea alba and its vascular openings, which are numerous around the umbilicus; this latter is corrugated, and very resisting; these openings are more or less dilated by particles of fat; a cellular layer, which is very dense, also exists there, especially around the umbilicus; finally, in this point only, are situated the umbilical cord and the urachus; then the whole of the peritoneum adheres firmly to the preceding layers the entire length of the region.

2. At the rectus muscle, which is visible when the trunk is flexed, we find successively; the skin, which adheres slightly, the superficial fascia, the anterior wall of the sheath of the rectus muscle, which is doubly formed by the two oblique muscles above, and is triple below,

by the addition of the transversalis; sometimes this contains, in the doubling of its layers, the pyramidalis muscle, and this is sometimes situated on the rectus muscle. Next comes the rectus muscle, then in its thickness and behind it, the epigastric artery below, and above, the internal mammary artery, which proceeds toward the umbilicus; behind this muscle superiorly, the posterior wall of the sheath of the rectus muscle, which wall is doubled from the obliquus internus and the transversalis below, the sub-peritoneal cellular tissue and the peritoneum, which we find above only under the preceding aponeurosis, to which it adheres firmly.

3. On the sides of the rectus muscle, we find successively; the skin, which adheres slightly; the superficial fascia, which frequently contains between its layers much fat; the sub-cutaneous artery, which is directed obliquely from the centre of the crural arch toward the umbilicus; the veins and superficial lymphatic vessels; the obliquus externus muscle, with its aponeurosis, and posteriorly only on the same plane, the latissimus dorsi muscle; then between the two, a triangular space, where the obliquus internus muscle is situated, in which space the abdominal wall is weaker than in the adjacent parts. Next, the obliquus internus muscle is seen in every part, excepting below and on the outside of the rectus muscle, in a triangular space already mentioned, where the aponeurosis of the obliquus externus corresponds to the inguinal canal: the transversalis muscle lies under the obliquus internus muscle, which covers the transverse fascia only below, while we find more deeply a loose cellular tissue, containing the epigastric arteries, which are directed obliquely from the centre of the crural arch toward the umbilicus, and finally the peritoneum, which adheres but slightly. The lumbar vessels and nerves, which go obliquely downward and forward, are situated at the flank, between the transversalis and the obliquus internus muscles; anteriorly, on the contrary, between this and the obliquus externus, they are extremely small. It follows from these remarks, that the abdominal wall has no large vessels on the outside of the umbilicus and rectus muscle, the epigastric and mammary arteries being turned inward; and that the lumbar vessels of this part are only capillary twigs.

Such are the relations of nearly all the ilio-costal region; but there is one point where these relations are so important that they demand a more minute examination; it is that of the inguinal canal, which serves for the transmission of the spermatic cord in the male, the round ligament of the uterus in the female.

Inguinal canal. The inguinal canal is flattened from before backward: it is an inch and a half long, and its direction is oblique forward and downward: it occupies the abdominal wall in a space

already mentioned, a space which is bounded on the inside by the rectus muscle, below by the crural arch, above by the lower edge of the obliquus internus and transversalis muscles united: this part of the abdominal wall would be very feeble, unless a special aponeurosis, the transversalis, was added.

The inguinal canal presents a central part and two openings; the central part presents four parietes; one of the two openings is superior, the other inferior.

1. The anterior wall of this passage is formed by the aponeurosis of the obliquus externus muscle, covered by the superficial fascia, the tegumentary vessels, and the skin. 2. The posterior wall is formed by the transversalis fascia, covered posteriorly by the epigastric artery and the peritoneum. 3. The lower wall is formed by the reflected groove of the crural arch. 4. The upper wall is bounded less distinctly, by the lower edge of the obliquus internus and transversalis muscles.

The interior of the canal is also lined by the canalicular prolongation of the transversalis fascia. The upper or peritoneal orifice looks backward, and has the form of a fissure; its inside is falciform and very strong, and the epigastric vessels are situated against it; the external presents nothing remarkable; this orifice belongs entirely to the transversalis fascia; it is closed by the peritoneum, which presents there a slight depression, and is extended there by a cellular filament.

The lower orifice is oblique, and has already been described; it is the inguinal ring. Its circumference gives rise to a thin fibrous expansion, which descends on the cord, and is covered by the superficial fascia and the skin. Farther, when cut obliquely outwards, the abdominal wall is very much weakened in this point, which is here formed only by the skin, the superficial fascia, the very thin expansion detached from the circumference of the ring, the transversalis fascia, and the peritoneum. The inguinal canal is larger in the male than in the female, and contains in the former the spermatic cord, and in the female the round ligament of the uterus, a cellular prolongation of the peritoneum, a remnant of the tunica vaginalis, or of the canal of Nuck, a canal of the transverse fascia, the cremaster muscle, and some adipose tissue.

The inguinal canal is at first very narrow; it enlarges in the male after the descent of the testicles; in the first periods it contains the prolongation of the peritoneum, which is soon obliterated; this is the neck of the tunica vaginalis in the male, and the canal of Nuck in the female.

Development. The costo-iliac region is formed of two pieces, which unite on the raphe. This union occurs late in one point, and there remains during the whole of fetal life an opening, which is afterwards

obliterated; this is the umbilical ring, through which the umbilical cord passes.

Umbilical ring. This opening is situated at first far below the centre of the body; it arrives at this point the sixth month of pregnancy; the cicatrix, which replaces it in the adult, occupies a higher region. Its circumference is entirely fibrous, and adheres loosely above on the right to the umbilical vein; it is formed below by a straight edge, by which it is intimately united to the urachus and to the umbilical arteries. The peritoneum, and even the intestine, pass through the umbilicus in early life, and go into the cord; after birth, and even from the tenth week of fetal existence, this is not seen in the normal state; its size is inversely as the age; in the adult, its parietes are so corrugated and so near, that its opening is seldom permeable; anteriorly, it is covered by the skin, and a compact cellular tissue, posteriorly by the peritoneum, which adheres very firmly.

Varieties. The whole ilio-costal region is very much developed in proportion to the others in the fetus. In old men, it often increases by the accumulation of fat under the skin. In the female, it is broader below than in the male; it is thicker, on account of the fat, except in those who have borne many children; in the female, also, the inguinal canal is narrower; it presents many other individual varieties, in respect to resistance. In females who have borne many children, this region is flabby: the skin which covers it presents at the lower part numerous cicatrices, marks of its distention.

Uses. This region possesses a very great resistance, on account of the muscles and their aponeuroses, which form the layers, the fibres of which have different directions in each, and cross obliquely: the parts where it is feeble, are its inguinal part, the linea alba at the umbilicus and at its vascular openings, behind the space included between the obliquus externus and the latissimus dorsi. This wall is susceptible of motions, in consequence of which it is sometimes convex, and sometimes concave anteriorly.

Pathological and operative deductions. This region may be partially or entirely deficient from a primitive arrest of development; the umbilicus may remain open after birth, and allow the peritoneum and intestine to pass out. Wounds of this part are always serious, because the cicatrix which follows is weaker than the uninjured wall, and because they thus dispose to hernias; we do not here allude to the severity of penetrating wounds; they give rise to hernias much more quickly the lower their situation, as the viscera tend to this part by their specific gravity; hence the precept to divide these wounds upward. This wall being weakened very much during pregnancy, is sometimes depressed by the weight of the intestines, and tu-

mors form which are termed eventrations. This wall is punctured in ascites: the slightly vascular state of the part which corresponds to the outside of the rectus muscle at the level of the umbilicus, explains why this point is so frequently selected for this operation; it may also be performed on the median line, excepting at the lower part, where the bladder may be endangered, as we shall see hereafter. In operations on the abdomen, the incisions must generally be made horizontally, to avoid the external vessels which have a transverse direction: hence in hysterotomy performed on the outside of the rectus muscle, the method of Lauverjat should be preferred to that of the ancients, where the first incision is made parallel to the median line. When performed on the raphe, this operation endangers no important artery of the abdominal parietes; this, however, may not be the case with the uterus. The size of the areolæ of the skin and of the portions of cellular tissue in this part, accounts for the frequency of biles and of anthrax in this region. The diseases of the subumbilical portion of this region are attended with the engorgement of the inguinal lymphatic glands, those of the part above the umbilicus cause the tumefaction of the axillary ganglions, as may be imagined from the arrangement of the lymphatic vessels. This region is necessarily divided, in order to tie the aorta and the external and internal iliac arteries, and in operating for artificial anus, when the rectum is deficient: we shall mention these operations, when speaking of the posterior wall of the abdomen. The inguinal canal is larger in the male, and hence inguinal hernias are more frequent; in these hernias, sometimes the viscera pass through the whole canal, proceeding through its upper opening, and gliding before the parts which it contains: these are the external inguinal hernias, which have the epigastric artery on the inside of the neck of their sac: at first, these hernias are oblique like the passage through which they pass, but at a later period, they gradually crowd back the inside of the upper opening, enlarge this, and bring it to the lower orifice; they are then direct: sometimes the viscera depress the posterior wall of the inguinal canal on the outside of the rectus muscle: in fact, in this place, this wall, formed only by the transversalis fascia, is much more feeble, as it corresponds to the inguinal ring, and wants support on the outside: in this hernia, termed the internal inguinal hernia, and which has the epigastric artery on the outside of its neck, the viscera are situated on the inside of the spermatic cord or of the round ligament, and are enveloped by the skin, the superficial fascia, the fibrous expansion of the inguinal ring and the peritoneum, the tunnel-shaped prolongation of the transverse fascia and the cremaster. The internal hernias, on account of the manner in which they pass through the canal, are al-

ways originally directed from behind forward. The tumor which constitutes inguinal hernia often stops in the canal, and it is then bubonocele: sometimes the adipose bodies of the inguinal canal enlarge and form lipomata, which resemble epiploic hernia: these adipose buttons sometimes draw down the peritoneum or the posterior wall of the passage to which they adhere, depress them, and cause the formation of peritoneal sacs, into which the intestines soon descend; they there form fatty inguinal hernias, which may be external or internal. Sometimes the testicle on descending into the scrotum is followed by a fold of intestine, then the neck of the vaginal tunic cannot be obliterated, and a congenital hernia is formed, which is from its nature external: sometimes, if this cause does not exist, the neck of this tunic is permeable, and then if it becomes the seat of an accumulation of serum, congenital hydrocele exists: diseases of the testicle or of its cord, by drawing this, sometimes bring also the peritoneum in the form of a sac into the inguinal canal. The lipomatous swelling of the adipose masses of the inguinal canal dilate and weaken it: if then the patient suddenly loses flesh, hernias occur easily; when a hernia continues a long time, if it exactly fills the canal, its neck is soon obliterated; but a cellular or fibrous filament continues in the inguinal canal, which resembles that of the neck of the obliterated sac of the vaginal tunic. Sometimes the testicle stops in the inguinal canal, dilates it and weakens it much, which also disposes to hernias when it descends lower. In the adult, hernias seldom occur through the umbilical ring, but through the openings of the linea alba, which are very numerous, and are very near each other; in the child, however, this is not the case. Umbilical hernias also may be congenital. We have mentioned a normal hernia of the small intestine through the umbilicus, in the early months of fetal existence, which continues abnormally in congenital hernia. Hernias in the linea alba are more frequent around and above the umbilicus, for the anatomical reason, that the number of vascular openings is greater in these parts. Vesicles of fat, engaged in the openings of the linea alba, their frequent enlargement, the traction they exercise on the peritoneum to which they adhere, explain the formation of hernias of the linea alba, a formation analogous to that of the fatty inguinal hernias: all the hernias of the linea alba, including those of the umbilicus, are remarkable for their superficial position; they are enveloped only with skin, a thin layer of cellular tissue, and the peritoneum. Even this last envelope in old and large hernias becomes so thin, that it is hardly visible, and seems not to exist, whence some surgeons have asserted that it is never present. The peritoneal envelope, however, always exists at the commencement, but the hernia soon increases, and the peritoneum adhering on the median line, as has

been stated, and unable to yield, is corroded, or rather is enormously distended and is absorbed, and we find no traces of it. The absence of the obliquus externus muscle posteriorly in the posterior abdominal wall, and the feebleness caused by this, explains the formation of hernias in this point, as we shall mention hereafter. In females who have borne many children, the recti muscles are very much separated, the openings in the linea alba are dilated; hence the frequency of hernias in this point.

PARAGRAPH SECOND.

OF THE POSTERIOR ABDOMINAL WALL.

The posterior wall does not present externally very prominent limits below; above, the prominence of the lower edge of the twelfth rib, and on the outside, the projection of the sacro-spinal muscles, mark its boundaries a little better. This wall, however, like the preceding, above the first rib, belongs also to the thorax and the abdomen; it is constituted by the lumbar and iliac regions, and forms by uniting to the anterior wall, the groin.

1. LUMBAR REGION.

This region is unmated, symmetrical, and is situated in an antero-posterior median plane; its limits are very exact above, the oblique line represented by the twelfth rib; below, the iliac crest, laterally, the outer edge of the sacro-spinalis muscle, which is prominent in very powerful individuals. This region has a cutaneous and peritoneal face; the first presents on the median line a raphe, and on the sides an elongated prominence; this is the projection of the posterior vertebral muscles; this face is convex transversely and is concave from above downward, and more so in the female than the male. The second is convex in every direction, and owes this arrangement to the curve of the spine, which may sometimes be felt through the anterior wall of the belly; most of the abdominal viscera rest against it. Farther, the peritoneum adheres to it but very slightly; it is separated from it by much cellular tissue and by the kidney.

Structure.—1. *Elements.* This region is formed very naturally; its skeleton is the lumbar portion of the spine, which forms most of it; the layers of the vertebræ, which are not interlaced, show the yellow ligaments; the spinous processes are long, horizontal, and their summits are directly under the skin; the upper articular processes are enlarged

by a kind of accessory transverse process. The vertebral canal is narrow, and the inter-vertebral foramina are very broad; it contains a cluster of nerves, which go toward the lower extremities and to the pelvis. The muscles may be divided into intrinsic and extrinsic: the first are the lumbar inter-transverse and the quadratus; among the second, we mention the sacro-spinalis, which at this height has only two fasciculi; first, the mass of the sacro-lumbalis and the latissimus dorsi; second, the semi-spinalis dorsi, a muscle which is named improperly, as it is not attached to the transverse processes, but to the tubercles of the upper articular processes: we also mention the serratus posticus superior, and the two psoas muscles; the latissimus dorsi and the diaphragm also enter somewhat into the structure of the lumbar region; the diaphragm contributes, however, only by its pillars.

The aponeuroses are more numerous and stronger in the loins than in any other part of the body. They all belong to the muscles; that of the transversalis, single on the outside of the region, it is there divided into three distinct layers; the anterior is attached to the base of the transverse processes of the region; the centre is inserted in the summit of the same eminences; finally, the third in the spinous processes; this last is strengthened by the aponeurosis of the obliquus abdominis externus muscle, and by that of the latissimus dorsi and the serratus posticus inferior muscles.

The skin is here remarkable only for its thickness, which is greater than on the anterior wall, and by its slight degree of sensibility, it presents but little hair. The peritoneum hardly exists, and is entirely accessory. The aorta terminates in this point, sometimes at the base of the region, sometimes a little above it; sometimes, but rarely, entirely above it, as we have seen. From this point, it sends its branches from the anterior and lateral faces, to the abdominal viscera, while it gives off, from its posterior face, the arteries of the region, the lumbar, which divide into an anterior and posterior branch: this latter belongs particularly to the vertebral canal, and to the posterior muscles; this region also receives some filaments from the circumflex iliac artery, the end of which anastomoses with one of the lumbar arteries. The lumbar veins follow the course of the arteries exactly; like them, they communicate with the renal vessels by some small branches, which come from the latter, and are distributed to the external fat of the kidney. All go into the vena cava, which follows the course of the aorta, and differs from it only in giving off no intestinal branches. The anastomotic origin of the azygos vein belongs to this region. The lymphatic vessels are superficial and deep; the first go into the inguinal ganglions, and some into those of the axilla. The deep vessels all converge toward the numerous ganglions, which are situated

in front of the spine, and which receive with the lymphatic vessels of the region all those from the lower parts of the body, and also those of the testicles or ovary. All these vessels unite, and form the commencement of the thoracic duct, which is often dilated, and constitutes the reservoir of Pecquet, which is much more frequent than authors admit.

There are two orders of nerves here; the tri-splanchnic nerve presents here its lumbar portion, composed of five ganglions, and of superior, inferior, external and internal filaments; we also find here the solar plexus before the lumbar portion of the aorta, and the lumbar nerves, when they emerge from the intervertebral foramina: their anterior branches form by an angular union the lumbar plexus. Farther, they leave also some filaments in the posterior layer of the union, through which the last intercostal nerve and the ilio-scrotal nerve pass diagonally. Much cellular and adipose tissue exists in the loins and the side of the belly, and but little posteriorly, beyond the transverse processes.

We find, also, in this region, the testicular vessels, or those of the ovary.

2. *Rélations.* In proceeding from behind forward, from the skin toward the peritoneum, the relations of the lumbar organs are the following: first, the skin, lined by a dense cellular layer, which attaches it very intimately in the centre to the supra-spinal lumbar ligament; second, a cellular layer, slightly fatty particularly at the median line, which is depressed in a direct ratio with the *en bon point* of the individual; third, the origin of the latissimus dorsi muscle, blending with the serratus posticus inferior muscle, which lies under it; fourth, an aponeurosis, formed by the union of that of the obliquus internus and the posterior fold of the transversalis muscle; fifth, the mass of the sacro-lumbalis and the longissimus dorsi, with the semi-spinalis dorsi muscle, situated on the inside and below; between them, some branches of vessels and nerves; sixth, a plane, formed by the transverse processes, the intertransversarii muscles, the central fold of the aponeurosis of the transversalis, and the layers of the vertebræ, which show the yellow ligaments; seventh, the quadratus lumborum muscle, and the ilio-lumbar ligament; eighth, the very thin anterior fold of the aponeurosis of the transversalis muscle; between this and the preceding muscle, the anterior branch of the last lumbar nerve and of the ilio-scrotal nerve, with some considerable vascular branches; ninth, on the outside, the kidney, with the adipose mass which surrounds it; on the inside, the psoas magnus muscle, between the fasciculi of which the lumbar plexus is situated; between this same muscle and the bodies of the vertebræ, some osseous and fibrous canals,

in which glide the arteries, veins, the deep lymphatics of the loin, and the anastomotic filaments of the great sympathetic nerve; when the psoas parvus muscle exists, it is situated on the outside and in front of the psoas magnus, with the ureter and the spermatic vessels; tenth, from the skin to the peritoneum, the spine separates the right and left parts of the region, which are perfectly similar on both sides; here, the convex part of this osseous frame forms an anterior layer, before which are situated the pillars of the diaphragm, on the right the vena cava, on the left the aorta, entirely on the outside, the great sympathetic nerve, above, the origin of the thoracic canal and of the azygos vein, and farther forward, the lumbar lymphatic ganglions and much loose cellular tissue.

Development. The median raphe indicates sufficiently the development of this region, by two lateral parts, primitively distinct, and united at a later period on the median line; the spine, particularly, presents this arrangement in a very marked degree; its posterior parts are not completely formed at the period of birth.

Varieties. In the female, this region presents a greater curve than in the male; numerous individual varieties are also seen.

Pathological and operative deductions. The loins curve laterally in persons affected with rachitis; and what is also remarkable, on the side opposite to that of the deviation in the thorax. In market women, this region curves much more than in the normal state. Spina bifida often appears here; the development of the whole spinal region, and particularly of this region, explains this phenomenon. Wounds in the loins, if made by a pointed instrument, may penetrate into the vertebral canal, between the layers of the vertebræ, and may cause severe symptoms. The superficial position of the spinous processes explains their frequent fractures, and also those of the layers caused by a counterblow. Fractures of the skeleton of the lumbar region paralyze only the lower extremities and the organs contained in the pelvis, a phenomenon connected with the distribution of the lumbar nerves. Moxas should not be applied in this region, if we wish to act directly on the medulla, which in fact terminates at its upper limit. J. L. Petite has seen one case of lumbar hernia; M. J. Cloquet also mentions a case of it. The less degree of resistance between the limits of the obliquus externus and the latissimus dorsi, accounts for the formation of this lumbar tumor; renal urinary fistulæ may exist in the lumbar region, a little on the outside. Abscesses in this part are not rare; sometimes they are phlegmonous, sometimes they depend on a disease of the skeleton of the region; the first may be situated in all the cellular spaces under the skin, in the sheath of the sacro-spinalis muscle, or in that of the quadratus, around the kidney, &c. Of the abscesses of the second

kind, some are situated necessarily at the posterior part of the region, and are seen in this direction, if the layers of the spinous processes, or the processes themselves, are affected; in these cases, the central fold of the aponeurosis of the transversalis always prevents the pus from going forward; other abscesses, which result from the alteration of the bodies of the lumbar vertebræ, cannot, for this reason, go backward, and the pus descends along the psoas muscle, when the disease of the vertebræ is situated at the level of the muscle, sometimes continuing out of its sheath, and following the femoral vessels, when the sub-aortic part of the vertebræ is carious. The operation of *nephrotomy*, and also that for artificial anus, as proposed by Callisen of Copenhagen, must always be proscribed, on account of the thickness of this region, and particularly the large nerves and vessels, which must be divided to perform them. In this region, Cooper has tied the aorta; but he divided the anterior wall of the abdomen on the median line; in the cadaver, the aorta may be tied without opening the peritoneum, by making an incision perpendicular to the loins, on the outside of the sacro-spinalis muscle. This mode of operating on the living subject is more objectionable than nephrotomy, and hence it should be rejected. Farther, the ligature of the aorta is also a very serious operation, not because it prevents the circulation in the lower extremities, for this is remedied by the collateral circulation, but because it cannot be performed without opening the peritoneum, and consequently without giving rise to peritonitis, which may be fatal; finally, because, as the ligature cannot be placed except below the very large collateral arteries, the lumbar and intestinal arteries, a fatal hemorrhage would inevitably ensue upon its removal. Ligatures of the aorta may be successful in dogs, but should not be adduced in favor of this operation in man; we know, in fact, that in these animals, hemorrhages, in consequence of arterial ligatures, rarely occur, and peritonitis is much less serious. Engorgements of the lumbar ganglions, which may be felt by pressing the abdomen anteriorly, may arise from diseases of the lower extremities, of the testicles, or of the pelvic organs. Masses of different characters, which may be seated in the ganglions, sometimes surround the aorta and vena cava, and impede the circulation in the lower extremities. The vascular relations between the kidneys and the lumbar region, explain the efficacy of leeches applied in this point for nephritis, &c.

2. ILIAC REGION.

It is composed of the parts which rest on the internal iliac fossa, and may be described hereafter when speaking of the haunch; it is bounded very naturally by the spine, the iliac crest, and the crural arch. This region presents only a single loose face, the peritoneal, which is concave and which supports the cœcum on the right and the sigmoid flexure of the colon on the left; its surface may be felt by depressing the anterior abdominal wall.

Structure.—1. *Elements.* The skeleton of this section of the posterior abdominal wall is represented by the internal iliac fossa, which is thinner in the centre than in any other part. The iliacus muscle should be considered as the special muscle; it fills the region and preserves its form; the psoas magnus, and psoas parvus when it exists, are also situated there, in a part of their course. The preceding organs are kept against the skeleton by a very strong aponeurosis, which forms a complete sheath for them: this aponeurosis is termed the iliac fascia; it is attached above on the ilio-lumbar ligament and on the inner lip of the iliac crest, on the inside to the margin of the upper strait of the pelvis; it is continuous with the outer third of the crural arch, and at the same point with the fascia transversalis; it is united under the crural arch with the deep layer of the fascia lata, which is continuous with it; in this place also, it is strengthened by the expansion of the tendon of the psoas parvus muscle. Its two faces adhere but slightly. It is stronger at the iliacus muscle, and weaker at the psoas muscle. This internal iliac sheath is perfectly closed upward, outward, and inward; it is continued to the thigh by the fascia lata, and terminates in a point near the small trochanter. The peritoneum of this region is very dense; it adheres slightly. The arteries come from the circumflex iliac, from the last lumbar, and from the ilio-lumbar artery. The first two form an important anastomotic arch on the iliac crest; the third is distributed in the centre of the region. The primitive iliac artery and the external which continues it, are situated on the inner limit of this region, and it usually gives off the epigastric and the circumflex iliac artery, on leaving the region. The veins follow the arteries exactly; we must however remark, that the iliac vein, on entering at the lower part of the region, receives from the subpubic foramen a large vein, which represents the course of the obturator artery when it comes from the epigastric or from the external iliac artery. A body of ganglions occupies the internal part of the region accompanying the external iliac artery; these ganglions receive the

vessels from the whole corresponding lower extremity and those of the region. The nerves come from the lumbar plexus, some of them, however, only pass through it and give off no branches; the crural and the genito-crural proceed perpendicularly, the inguino-cutaneous branches obliquely outward. Adipose tissue exists there only superficially, and in small quantities; the cellular tissue is very loose in every part.

2. *Relations.* In reviewing the iliac region we find, under the peritoneum and the intestines which it confines, a very loose cellular and adipose layer; on the inside, in the course of a line drawn from the umbilicus to the centre of the crural arch, the primitive and external iliac arteries, having at their inner and lower part their attendant vein covered by some lymphatic ganglions; second, the fascia iliaca aponeurosis which forms a layer moulded on the following; third, the iliacus and psoas muscles on the inside, forming a layer which is slightly elevated, on which we observe an angle where the crural nerve is situated; we also find directly before these muscles the genito-crural nerve on the inside, the inguino-cutaneous nerve on the outside; most of the vessels also lie under the aponeurosis; the anastomotic arch mentioned, and particularly the circumflex artery, are situated in a small sheath formed by the doubling of the iliac fascia. The branch of the ilio-lumbar artery at its origin passes under the psoas muscle. All these sub-aponeurotic parts are united by a very loose cellular tissue.

Development. For a long time this region is rudimentary, when compared with the rest of the abdominal parietes. It does not acquire its proportional extent until after birth, and at the period of puberty; at this time it enlarges transversely in the young girl, while in the boy, its vertical extent predominates.

Varieties. The arterial trunk which passes through this region varies much; in fact, this vessel sometimes gives off the obturator artery, sometimes near the crural arch, sometimes more or less above, and rarely below it. The epigastric and circumflex arteries may also arise unusually high. We sometimes find in this region an abnormal muscular fasciculus, which terminates on the common tendon of the psoas and iliacus muscles.

Pathological and operative deductions. The iliac region may be entirely deficient with its corresponding limb; its slow development explains this monstrosity. Instruments which wound this region must affect the anterior abdominal wall. If they penetrate internally, they may mortally wound the external iliac artery; external wounds are always less serious. In operations, the surgeon may arrive at this part of the abdomen in a similar manner. Thus Duret has formed here an artificial anus, in a child where the rectum was deficient, by bringing

outward the sigmoid flexure of the colon ; he seems to have opened the peritoneum. This, however, may be avoided, by operating on the posterior face of the intestine, and opening it in that part, where it has no serous membrane. The ligature of the external iliac artery also belongs to this region. The primitive iliac artery has also been tied in the same point, and a ligature has been applied successfully to the hypogastric artery by Dr. Stevens. Our remarks on the anterior abdominal wall, imply the necessity in these operations of making incisions oblique from the groin towards the flank, without approaching too near the iliac crest ; this has been the mode followed by those skilful surgeons who have performed the operations mentioned, and first by Abernethy. In this manner, we operate between the epigastric and circumflex arteries which are avoided, and particularly on arriving at the peritoneum at its point of reflection, it is easily separated from the iliac fascia to which it slightly adheres ; we may then touch the artery on the inside of the region, which must be raised from within outward, to avoid taking its attendant vein, which is situated on the inside ; the crural nerve is no obstruction, it is separated from the vessels by the psoas muscle and enclosed in its sheath. In order that the ligature of the external iliac artery may succeed, it must not be applied directly below the origin of the circumflex and epigastric arteries, in conformity to the general rule in tying the arteries ;* the varieties in these vessels probably account for the number of unsuccessful operations. In order to be more certain of tying the external iliac artery in the place we wish, we may follow the ingenious process of Bogros, which consists in dividing the abdominal wall according to the course of the crural arch near its middle third, so as to cut successively ; the skin, the fascia superficialis, the aponeurosis of the obliquus externus, after which we come to the spermatic cord or the round ligament, the united edges of the obliquus internus and transversalis muscles, we separate the fascia transversalis, and then by following the epigastric artery, which is seen in the course of the wound, we cannot fail of coming to the iliac artery. Cooper's method resembles this a little ; he makes a curved incision. Farther, this operation would still be insufficient to tie the iliac artery above the epigastric artery, in a variety where this vessel arose unusually high. Abscesses are frequent in the iliac region ; they are idiopathic or symptomatic ; the pus which then forms, always points towards the thigh. Idiopathic abscesses may exist under the aponeurosis or peritoneum ; this is true also of abscesses by congestion ; the latter do not present the first character, except when caries affects the ilium, or the sides of the lum-

* An artery should be tied as far as possible below a collateral branch.

bar vertebræ ; in other cases, they are situated under the peritoneum. The sub-peritoneal abscesses of the iliac fossa do not affect its muscle, and point toward the thigh on the inside and in front of the femoral vessels. The sub-aponeurotic abscesses point in the iliac sheath, and near the small trochanter, on the outside of the femoral vessels, and burrow through or destroy the muscles of this region.

OF THE GROIN.

The iliac region unites with the anterior abdominal wall, and forms an angle, open on the side of the belly, and extending from the anterior and superior spine of the ilium to the pubis, near which, also, the pelvic limb joins these two regions : this is the groin. This region is marked externally by an oblique fold, from the flank to the pubis, and is very distinct in fat individuals, and while the corresponding limb is flexed. The skin is hairy in that part, and the hand readily perceives under it some small prominences, which are the superficial inguinal ganglions.

Structure. The anterior edge of the iliac bone forms the skeleton of this region ; it presents two anterior iliac spines, separated by a fissure, the groove of the psoas and iliacus muscles, the ilio-pectineal eminence, the crest of the pubis, and the triangular surface, belonging to the pectineus muscle, the spine of the pubis, and a surface which contributes to form the inguinal ring. This great fissure is changed into a foramen by the crural arch, (the reflected edge of the aponeurosis of the obliquus externus muscle.) The latter is attached very simply on the iliac spine and the pubis ; it is separated into two fasciculi, mentioned above ; its lower edge is continuous, on the outside, with the entire fascia lata, on the inside, with its superficial layer only ; its posterior edge is reflected upwards, and is continuous in its external third with the fascia iliaca ; in its middle third, with the fascia transversalis ; and in the internal third, it is attached to the crest of the pubis, and thus forms Gimbernat's ligament, which has an upper and anterior face, and a posterior and inferior face. Gimbernat's ligament is attached by one of its edges on the crest of the pubis, and by the other on the crural arch ; this latter, which is the base of the triangle represented by this part, is concave, and turned outward. In consequence of this arrangement, the opening formed by the crural arch with the iliac fissure is loose only in the centre, and represents a triangular ring, the anterior edge of which is formed by the crural arch, the posterior by the horizontal ramus of the pubis, and the external by the sheath of the psoas and iliacus muscles, strengthened in this point

by an expansion of the psoas parvus muscle; the inner angle of this ring is blunt, and occupied by Gimbernat's ligament; the posterior includes the femoral vessels, while the external is unimportant.

If we now examine the relations of this opening, we find that its anterior edge is covered from within outward by the skin, the fascia superficialis, the sub-cutaneous abdominal artery, some lymphatic ganglions, to which the superficial lymphatic vessels proceed from the genital organs, from the corresponding limb, and from the lower part of the abdominal wall: in this anterior edge we find, finally, the inguinal canal, and also the spermatic cord, or the round ligament. The posterior edge is formed by the horizontal ramus of the pubis, covered by the pectineus muscle, which conceals anteriorly the deep layer of the fascia lata. Finally, the epigastric vessels are situated near the outside, and in the sheath which forms this wall of the crural opening; we find from within outward, the crural nerve, the psoas and the iliacus muscles, and the inguino-cutaneous nerves, situated between the two iliac spines. This triangular opening of the groin is closed by a cellular layer, which Cloquet proposes to call the crural septum: it is the propria fascia of some writers. This layer is of little importance, and adheres to nearly all the edge of the opening: the peritoneum is separated from it by a triangular space, formed by the place where it is reflected to go from the anterior wall of the abdomen to the iliac fossa. On the side of the thigh this opening is continuous with an interstice which we shall describe hereafter, of which it forms the upper orifice; this is the crural canal, which is of but little importance compared with the opening of which we are speaking. This true foramen contains the femoral vessels in its posterior and external angles, the vein on the inside of the artery; near Gimbernat's ligament, a large lymphatic ganglion always exists, and often another before the crural vessels, with a plexus of deep lymphatic vessels, which go to the iliac ganglions. The cellular tissue contained is very loose, and but little fat exists there.

Varieties. In the female, this opening is greater transversely than in the male, as it is more flaring. In the normal state, the crural opening on the outside is near the epigastric artery, anteriorly, the inguinal canal and the parts which it contains; the femoral vessels rest on the external posterior part, and we find only a small vessel behind Gimbernat's ligament: sometimes, on the contrary, a very large artery, (the sub-pubic or obturator artery,) arises in this point from the epigastric artery, and then the whole circumference of the opening is contiguous to remarkable vessels, except its posterior and internal part, which is bony; the obturator artery arises from the epigastric artery once in ten times; but the relations of these two

vessels at their origin are rarely such that the obturator artery passes on the external or concave edge of Gimbernat's ligament; in order that this may occur, this vessel must come from the epigastric artery about an inch below the origin of this from the iliac. When the distance is less, the obturator artery descends directly toward the subpubic foramen, and does not touch Gimbernat's ligament; when, on the contrary, the distance is greater, and this is rare, it descends toward the obturator foramen, and is situated far from the base of this ligament, and has no relations with the anterior side of the ring, the crural arch.

Pathological and operative deductions. The diseases which appear in the groin may be situated in the crural opening, or on the outside, in the parts around it.

The abdominal viscera often descend into the crural canal, enveloped with the herniary sac; this is crural hernia, which is more frequent in the female, on account of the greater size of the crural opening compared with that of the inguinal canal. The neck of the sac of the femoral hernia generally has the epigastric vessels on its outside; J. Cloquet, however, cites a case, where the hernia occurred on the outside of them, through an erosion of the fascia iliaca aponeurosis. The herniary parts descend before and on the inside of the crural vessels, push before them the crural septum, which they break after it has been distended; these hernias are enveloped by different layers, which are covered by the crural ring, the skin, the fascia superficialis, the crural arch, and the layer of the fascia lata which adheres to it at its commencement; finally, the crural septum is also doubled around the herniary sac, which comes next. The relations of the neck of the sac with the vessels are the same as those of the opening; hence, we can imagine why Scarpa advises to cut inward upon Gimbernat's ligament; the abnormal position on this of the obturator artery should induce us to adopt the advice given by Petite, to use a bistoury *à la lime*, an instrument which will cut the ligament, but which only crowds back the artery, which is attached but loosely; an incision upward and outward does not expose the obturator artery, when an anomaly exists, more than the preceding; it is more advantageous than that which is made anteriorly, because we are less liable to injure the spermatic cord, or the round ligament. Farther, in making the incision in crural hernia, in the manner Dupuytren advises, we must not forget that we cut very near the epigastric artery. A false or true aneurism may arise from the artery situated in this point. The contiguity of the artery and vein shows, a priori, the possibility of a varicose aneurism in this point; we have seen two cases of it. The pus of abscesses of the iliac region points in the crural opening, if it

be formed under the peritoneum; that which results from the caries of the bodies of the lumbar vertebræ anteriorly, also comes there, but follows the iliac vessels.

2. On the outside of the crural opening, we often find engorgements of different natures of the superficial ganglions, idiopathic or symptomatic engorgements; tumors of the inguinal canal, also, are referred to this point, and have sometimes been taken for diseases situated in the crural opening. On the outside, in the sheath of the psoas and iliacus muscles, we often find pus, which burrows through these muscles, and descends toward the small trochanter; pus may be formed there, or may come from the iliac and lumbar regions. When the hip is dislocated forward and upward, the head of the bone raises these muscles on the outside of the vessels, and crowds them a little back. Exostoses may be formed on the horizontal ramus of the pubis, and they then contract the opening by crowding the vessels forward. All the tumors situated here before the vessels, and those also which result from their dilatation, pulsate; in the former, they are simply raised; the second are characterized by motions of internal expansion.

PARAGRAPH THIRD.

OF THE SUPERIOR ABDOMINAL WALL.

This portion of the abdomen is formed by the diaphragmatic region, which has been described when speaking of the chest, of which it forms also the lower wall.

PARAGRAPH FOURTH.

OF THE INFERIOR ABDOMINAL WALL.

This wall, which includes the circumference of the cavity of the pelvis, forms for the abdomen a floor, concave upward, opposite in every respect to the diaphragm. It is composed of two parts, the perineum and the pelvic region.

ORDER FIRST.

OF THE PERINEUM.

The perineum is a large and very important region, formed by the group of organs situated in the area of the inferior strait of the pelvis. Its limits are the same as those of this strait; they are very visible.

Some anatomists confine the term perineum, in its etymological acceptation, to the genital region, or to the space between the genital organs and the anus; but we give it a broader sense.

The perineum presents, according to the sexes, such marked differences, which depend on those of the genital organs, that we, at first, made two distinct regions of it; but more mature examination demonstrated, that the elementary parts, and also the whole formed by their union, are very analogous; we shall, therefore, give some general remarks on the perineum, and then neglect the analogies, and attend solely to the sexual differences. The description will be based upon the adult age.

1. GENERAL REMARKS ON THE PERINEUM CONSIDERED IN THE TWO SEXES.

The extent of the surface of the perineum is estimated by drawing an antero-posterior, a transverse, and an oblique diameter; they vary much according to the sexes; consequently, their length, and likewise the height of the perineum, which dimension must be estimated in different points, cannot be mentioned in this chapter.

The perineum presents two faces, one cutaneous, the other peritoneal; the first is concave transversely, especially at the sciatic tuberosities, and is convex from before backward; it appears in the form of a longitudinal groove, on which the median raphe is very distinct: we find there the terminating openings of the digestive, urinary, and genital organs. The peritoneal face is more or less remote from the preceding, and presents variable peritoneal depressions. The urinary, genital, and digestive organs, pass through the perineum in curved lines.

Structure.—1. *Elements.* This region, properly speaking, has no skeleton; it is only circumscribed by some bones and ligaments. We find there, some intrinsic and extrinsic muscles; among the former we must mention first the levator ani; second, the sphincter, which terminates anteriorly on one of the aponeuroses of the perineum, and not, as

authors say, on the bulbo-cavernosus, the posterior extremity of which muscle also differs from the arrangement generally mentioned; in fact, it arises posteriorly from the inferior aponeurosis of the perineum; third, we find also in this place the ischio-cavernosus, and fourth, the transversus perinei muscle, which vary much in their existence, and their direction. We have mentioned here the bulbo-cavernosus muscle, because it exists in the female, as in the male, with this difference however, that in the former its two fasciculi separate to embrace the vulva, while in the second they unite under the bulb of the urethra; but this name should evidently be changed in this general description; that of ano-cavernosus is both more philosophical and more convenient. The glutæus maximus muscle, which belongs but in a trifling degree to this region, is extrinsic.

The skin and the peritoneum present nothing general to be mentioned in this place. The arteries are here very numerous; they come from a common trunk situated on the bounds of the region, in the parietes of the pelvis; this is the internal pubic, which rests in every part against the inner face of the pubic arch; the branches which it sends off in the perineum are; first, the inferior hemorrhoidal artery, which proceeds transversely towards the anus, behind the sciatic tuberosities; second, the superficial perineal artery, which comes into this region a little before the sciatic tuberosity, and proceeds on the outer limits of the perineum, constantly proceeding toward the median line, at which it arrives in the septum of the dartos, after giving off some small transverse branches toward the median line; third, the transverse or urethral artery, the direction of which is transverse, before the sciatic tuberosities, which varies much in respect to its origin and direction; in fact it often arises near the tuberosity, and goes obliquely toward the urethra. The veins generally follow the course of the arteries; we must nevertheless observe that the hemorrhoidal vein anastomoses with the origin of the small mesaraic vein, by filaments which pass through the fasciculi of the sphincter ani muscle, that the superficial perineal vein is very small and sometimes deficient, that the trunk of the pubic vein commences in the corpus cavernosum, and does not receive the blood from its dorsal vein, and finally, that the latter passes near the root of the penis, under the pubic arch, and contributes to form a very complex net-work around the neck of the bladder. The lymphatic vessels are superficial or deep; the first go into the inguinal ganglions, the second into the pelvis and into the hypogastric ganglions.

The nerves of the perineum nearly follow the course of the arteries; they have an anal, a superficial perineal, and a deep branch.

The perineum presents some remarkable aponeuroses. Of these

there are three, each forming a distinct horizontal layer, a superficial, a middle, and an inferior. We observe, however, that the inferior aponeurosis is deficient posteriorly, and exists only in the triangular space, bounded by the branches of the pubic arch, and by an imaginary line drawn between the two sciatic tuberosities. These aponeuroses have received different names; of these names the best are those which convey an idea of their position. They are all evidently continuous, so that they form anteriorly two sheaths, in which all the organs are successively situated.

The superior aponeurosis of the perineum, (the fascia pelvia, the recto-vesical aponeurosis,) occupies the base of the pelvis and lines its parietes; it is attached on the sides to the margin of the pelvis, where it is continuous to a slight extent with the fascia iliaca; it is united anteriorly to the posterior face of the pubis and of its horizontal ramus; posteriorly, it commences on the anterior face of the sacrum, in front of the sacral foramina; thence it descends in a curve, and terminates on the rectum, on the neck of the bladder and the genital organs. We may describe it as forming a floor, concave upward, perforated only to give passage to the rectum, the genital and urinary organs. It is more dense anteriorly, where it forms two strong folds, inserted on the pubis and the neck of the bladder, (the anterior ligaments of the bladder) between which are openings, through which pass the dorsal veins of the erectile organ. At the infrapubic foramen, this aponeurosis forms an arch, on which the obturator nerves and vessels rest; posteriorly, it presents a foramen for the passage of the lumbo-sacral nerve and the gluteal vessels; and another through which pass the pudic and sciatic arteries; it touches the peritoneum above, below it rests on the levator ani, the pyramidalis and the obturator internus muscles, the sacral plexus and the median organs of the perineum.

The middle aponeurosis of the perineum, (the aponeurosis of the levator ani,) the perineal ligament of Carcassomme, who saw it only anteriorly, arises on the outside and posteriorly, from the outer face of the preceding, at the upper edge of the levator ani muscle, and is inserted in the angle of separation; anteriorly it is inserted on the interstice of the branches of the pubic arch, being continuous with the inferior pubic ligament; it goes from thence on the sides of the bulb of the urethra, which it attaches very intimately on the median line, near the circumference of the edge of the anus, extending between the digestive, urinary, and genital organs, so as to form a second fibrous layer, which is perforated only, like the superior aponeurosis, to give passage to the median organs and to some nervous and vascular filaments. There is always a foramen under the symphysis pubis; the dorsal veins and arteries of the corpus cavernosum pass through it in

an opposite direction. This aponeurosis is very strong anteriorly and very feeble posteriorly; its superior face corresponds to the levator ani muscle, the inferior and external gives rise, on the outside, to a very strong fibrous layer, which descends perpendicularly on the sides of the pelvis, and consequently out of the region, and terminates on the inner edge of the great sacro-sciatic ligament; finally an aponeurotic layer, which retains against the ramus of the ischium, the internal pudic trunk. The point where these two aponeuroses separate forms an angle open downwards, which is filled by cellular tissue and fat. The inferior or superficial perineal aponeurosis exists only before a line drawn to the level of the sciatic tuberosities. We demonstrated this several years since,* and it was drawn in our plates; but then we did not know its importance and connexions. From the first dissection of this layer its description was necessarily imperfect, and it was proposed to call it the ano-urethral. We can now speak of it more in detail; it arises in front of the anus, between the sciatic tuberosities, from the lower face of the preceding aponeurosis; on the sides, it is attached very strongly to the external lip of the pubic arch; it is continuous anteriorly with the dartos muscle; it has the triangular form of the space where it is situated; it is dense posteriorly and feebler anteriorly, and is situated under the skin, as if to separate the anus from the urinary and genital organs. In man, the upper face of this covers the bulb of the urethra, the roots and muscles of the corpus cavernosum. In the centre of this face are inserted the bulbo-cavernosus or ano-cavernosus muscle, and the inferior, the anterior extremity of the sphincter ani muscle.

The cellular tissue in the perineum is particularly abundant downward and backward; it is more dense on the median line than in other points. A great quantity of fat is situated particularly around the rectum; we find but little or none between the inferior and middle aponeurosis: but little exists under the perineum; in regard to continuity, these tissues must be separated into four layers; the first is sub-cutaneous, the second is situated between the inferior and middle aponeurosis, the third between the middle and superior aponeurosis, finally, the fourth between this latter and the peritoneum. The second layer

* All authors mention the superficial perineal aponeurosis; it may therefore seem singular that this part is described here as something new; but the description will prove this to be the fact, and that the term, inferior perineal aponeurosis, has hitherto been applied to the sub-cutaneous tissue of the perineum, as can be seen in Dupuytren's splendid plates: this differs entirely from what we are describing. Farther, what is generally received as the inferior perineal aponeurosis is of no importance; this is not the case with that of which we are speaking. Some may say this aponeurosis is an appendage of the fascia superficialis of the abdomen; they will admit, however, that the perineal arrangement of this fascia has not been mentioned.

is separated from the first by the inferior aponeurosis, and communicates easily in the male with the dartos. All these parts press in some measure around the digestive, genital and urinary organs; the only part of the first which belongs to this region is the lower part of the rectum; it is destitute of peritoneum and describes a curve concave anteriorly; it occupies the median line, and some anatomists have wrongly stated that it deviated a little to the right; the rectum contracts very much before terminating, it thus forms the anus, the edges of which are corrugated and present longitudinal folds, at the base of which are follicles, which secrete a very odorous substance. The rectum before terminating presents an oval cul-de-sac, which is developed in a direct ratio with the age and the constipated state of the bowels; we have seen it so much dilated in old men, that it filled the cavity of the pelvis. The openings of the inferior follicles of this dilatation are directed upward, which disposes them to engorge with particles, or to retain pointed foreign bodies which come there from above downward. The urinary and genital organs cannot be mentioned in this general description; it is sufficient to say that they are united, and that the perineum always contains the bladder, the urethra, and the erectile organ.

2. *Relations.* The skin, the peritoneum, and cellulo-fatty layers, one of which is sub-cutaneous, the other sub-peritoneal, bound this region, the one below, the other above. All the other organs are situated between the inferior and middle aponeurosis, between this and the superior. Farther, the perineum presents two sections, an anal, and a genito-urinary, which are separated by a line which would pass before the margin of the anus. The relations of the first, which are very similar in the two sexes, can alone be mentioned here; under the skin we find, in this point; first, an abundant layer of cellular and adipose tissues, and on the sides particularly, a very large mass of the same nature, situated in an angle which is open downward, and is formed by the union of the middle aponeurosis with that of the obturator internus muscle. In the centre of this angle, and the tissue which fills it, the inferior hemorrhoidal arteries proceed, some lines behind the sciatic tuberosity; second, the sphincter, on the median line, and on the other points, the middle aponeurosis of the perineum, which is here inferior; third, the levator ani muscle; fourth, the superior perineal aponeurosis; fifth, a loose cellular layer, and the peritoneum in every part, except posteriorly, where the rectum is separated from the coccyx and from the sacrum only by a very loose cellular tissue, which is continuous with that of the meso-rectum.

Sometimes the rectum rests on all the points of this region, and

extends between the upper aponeurosis and the peritoneum, which is crowded very high upward, particularly on the sides.

Development. This region is formed by the central union of two parts primitively separated ; its normal openings may be considered as the remnants of this primitive separation. Before the second month of pregnancy, the perineum is cleft in two parts, and is similar in both sexes which are not as yet distinguished. This development serves to explain the abnormal obliterations or unions of the perineal passages, and the cases of hermaphrodism, which are always very imperfect in our species.

Uses. The aponeuroses of the perineum render it very firm ; the absence of the lower one, however, posteriorly, diminishes its resistance in this part ; its movements are communicated by its muscles, and particularly by the levator ani, the action of which is opposite to that of the diaphragm, and shortens the passages which pass through this region, by raising them.

Pathological and operative deductions. The anal portion of the perineum is sometimes deficient, and not only the anus, but the part of the rectum generally found there ; in this part it has been proposed to make an artificial anus. In addition to our remarks on this point, when speaking of the iliac and lumbar regions, we must add, that an artificial anus can be made through the perineum, in the place where the anus would naturally exist in the normal state ; in order to this, it has been advised to introduce a trocar toward the intestine ; this operation is often successful, but may cause bad symptoms, particularly the opening of the peritoneum, when a large portion of the rectum is deficient. We must not forget that where the anus is deficient, the intestine sometimes terminates in the urinary organs. Abscesses are often situated around the anus ; the complete close of the summit of the aponeurotic angle mentioned, explains why they never fuse from below upward, under the peritoneum, whatever may be their size. The peculiar arrangement of the follicles above the anus, explains the development of abscesses and fistulæ, which proceed from the rectum internally. Ribes thinks that the course of many of these latter is formed by one of the veins which pass through the sphincter. Hemorrhoidal tumors, as our dissections have proved, are all formed by varices. Sometimes one vein, and sometimes several are dilated, and form a group of small varices, the erectile appearance of which has certainly deceived pathologists. The absence of valves in these veins, (the roots of the vena portæ,) their passage between the fibres of the sphincter, and the impediment to the course of the blood, produced by the contraction of this muscle, explains the dilatation of these vessels. Sometimes the mucous membrane of the rectum is reversed ;

sometimes small and elongated ulcers are developed on the inner part of the sphincter, in the folds of the mucous membrane; these are fissures, which cause at first very severe pains, occasioned by the rubbing of the feces against the ulceration; these pains soon become constant and intolerable, and the sphincter muscle being constantly excited, finally becomes spasmodically contracted, and thus opposes the discharge of feces in a greater degree. Superficial diseases of the perineum cause the engorgement of the inguinal lymphatic ganglions, the deep diseases, that of the pelvic ganglions; these phenomena are explained by the termination of the two orders of the lymphatic vessels. Sometimes hernias exist through the perineum, depressing its different layers of organs; they appear most frequently in the region of the rectum, where the aponeuroses are less numerous and less resisting. The incisions made upon the anus for different purposes can never cause alarming hemorrhage, at least if they are made very far outward, or from the side of the rectum.

1. PERINEUM IN THE MALE.

The perineum in the male presents a surface which can be measured by drawing two diameters; first, the antero-posterior, the coccy-pubic, is four inches; the other, the transverse, the bi-sciatic, varies, according to Dupuytren's measurement, between two and a half and three and a half inches. The oblique diameter, which may be estimated in the same manner as the area of the lower strait of the pelvis, is entirely useless.

The height of the perineum in the male varies in different places; it is necessary to know it exactly: first, between the inner surface of the neck of the bladder and the raphe of the skin, ten lines before the anus; second, between the anterior part of the margin of the anus, and the base of the recto-vesical depression of the peritoneum; in the first point, in ten cadavers which we have examined, the height varied between two inches and two inches and eight lines; in the second, between two inches and ten lines and three inches and six lines. The perineum in the male presents two faces; one is cutaneous, the other peritoneal. The first presents a very distinct median raphe, and continues on the scrotum, which seems appended to this region; it is also covered with hairs, which are continuous with those of the bursæ. The only opening in it is that of the anus, which corresponds to the centre of a line drawn between the summit of the two sciatic tuberosities: anteriorly, we perceive on the median line a prominence, formed by the urethra and its bulb. The peritoneal face presents only one

depression between the bladder and the rectum; it varies in depth, and often receives folds of intestine.

Structure.—1. *Elements.* We find in man all those parts which have been mentioned in the general description, except his sexual organs; the muscles, however, are always more developed in him; the ano-cavernosus is indivisible; it, however, is inserted in a few points on the bulb of the urethra, which it covers, and hence its name of bulbo-cavernosus. We find under the pubio-vesical ligament, which should here be termed the prostatic, a fleshy fasciculus, which has the same direction and the same limits; it is the muscle of Wilson.

The vessels and nerves present nothing peculiar, except the great development of the superior branches, when compared to the inferior.

The perineal aponeuroses are so marked in the male, that his sex must serve for a type of general description; this great development forms their only differential character; the inferior aponeurosis is invisible.

The cellular and adipose tissues present nothing peculiar, except the easy continuity of that which is above the inferior aponeurosis, with that of the dartos. The rectum is more subject in the male to those enlargements which we have mentioned.

The bladder does not properly enter into the structure of this region, but rises above it; its neck, however, makes a part of it with the adjacent regions of the body, particularly the trigone; the neck is contracted, but very extensible; the clitoris is attached to it. Its entire circumference is surrounded by the prostate gland, which is very resisting, and is encircled by a slightly extensible fibrous membrane, which is very strong, particularly above, where the superior perineal aponeurosis is attached to it. This sheath of the prostate gland contains in its layers a net-work, formed by the numerous anastomoses of the veins of the prostate gland, of those of the neck of the bladder, with the dorsal veins of the penis. The prostate gland is situated beyond, and a little behind, the symphysis pubis; it is nineteen lines broad, and thirteen lines high; the urethra passes through it, generally nearer its upper than its lower region. If we wish to form an estimate in regard to the rays of the prostate gland, taking the surface of the neck of the bladder as the centre, we find that the inferior median ray in the normal state measures seven or eight lines, the transverse nine lines, and that which is directed obliquely backward and outward from ten to eleven lines; the superior median ray measures only a few lines.

Besides the urethra, the prostate gland also contains within it the ejaculatory ducts, which converge towards each other, and which become contiguous, and terminate at the urethra, at the anterior part of the

verumontanum; finally, we find in this region the spermatic vesicles, which converge toward each other at their anterior extremity, and are only a few lines distant in this point; the vasa deferentia are situated near each other on the inside, and flatten and terminate after becoming contiguous.

The neck of the bladder, when united to the prostate gland, the ejaculatory duct, &c. is suspended behind the symphysis by two very strong pubio-prostatic ligaments, which are but slightly elastic.

The first two portions of the urethra, the prostatic and the membranous, and even the bulb and the origin of the spongy portion, belong to the perineum of the male. The first is about twelve or fifteen lines long, and is dilated in its centre, particularly at the expense of its inferior wall; we find there the crest of the urethra, on the sides of which we see the adjacent orifices of the ejaculatory ducts, and the very broad openings of the lacunæ of the prostate gland. All this portion, and the half of the second, are situated behind the central aponeurosis, through which this passes six lines below the inferior pubic ligament. The membranous portion is ten lines long, it is narrow, and its parietes are thin; the bulb projects a little on its lower side. This spungy enlargement is included in the opening of the central aponeurosis, which terminates on its sides, and attaches it firmly on the median line; at the bulb, the urethra presents a dilatation, the ventricle of the bulb. The whole of the perineal portion of the urethra thus describes a curve, concave superiorly, which belongs to a circumference of five inches in diameter. This curve is a necessary effect of the drawing upward of the prostate gland, by the pubio-prostatic ligament, of the passage of the urethra through the middle perineal aponeurosis, far below the symphysis, and finally of the connexion of the penis before the pubis by its suspensory ligament; it cannot be effaced, on account of the slight elasticity of the fibrous parts which cause it. When the penis is drawn upward and laid upon the belly, all the perineal part of the urethra is tense; it is relaxed, on the contrary, when the penis is depressed and drawn forward. The consequences of these facts, when applied directly to the introduction of curved and straight sounds, are evident. The portions of the urethra of which we are speaking, are filled with follicles, (the lacunæ of Morgagni,) which present a large reservoir which looks forward, a kind of cavities which are particularly numerous on the lower wall. The roots of the cavernous body of the penis, the male erectile organ, are also situated here.

2. *Relations.* The relations of the rectal portion of the perineum, present no sexual differences. We have then only to mention those of the organs included in the area of a triangle, formed by the rami

of the arch of the pubis, and by a line drawn between the summits of the two sciatic tuberosities; it is the *genito-urinary region;* in proceeding from within outward, we find successively; 1. The hairy skin, which is separated into two parts by the raphe, in the course of which the sub-cutaneous tissue is very dense, while it is loose on the sides, and continuous with the cellular tissue of the anus, and that of the inner part of the thighs. 2. The inferior perineal aponeurosis, and in it, or directly under it, the superficial vessels and nerves of the perineum, situated in the course of a line drawn from the inner part of the sciatic tuberosity, towards the spine of the opposite pubis. 3. Between this and the central aponeurosis, first, a fleshy layer, formed by the bulbo-cavernosus, the ischio-cavernosi, and the transversus perinei muscle, next, the bulb of the urethra, and the half of its membranous portion in the centre, the roots of the corpus cavernosum on the outside, and between these parts a cellular interstice, in which a few vessels are situated. 4. The middle perineal aponeurosis, through which the urethra passes, and under it or in it, the transverse or bulbar artery, proceeding transversely fourteen lines in front of the anus. 5. Between this and the superior aponeurosis, the anterior fasciculus of the levator ani muscle, a portion of the membranous part of the urethra embraced by the preceding muscle, and on the sides of which are the glands of Littre and of Cowper, the prostate gland, the corresponding parts of the urethra, and the neck of the bladder. The membranous portion of the urethra is separated from the rectum in this point by a cellular space of ten lines only; the prostatic portion and the neck of the bladder, by the whole prostate gland, the corresponding ray of which is about eight lines; the neck of the bladder is covered above by some cellular tissue, by the dorsal veins of the penis, which form there an important net-work, and by the muscles of Wilson. The bladder and the rectum are always separated on each side between the middle and the superior aponeurosis, by the seminal vesicle and the vas deferens, which is flattened and placed on the inside of the former. These two parts are united behind the prostate gland, to the similar parts on the opposite sides; they diverge very much superiorly and anteriorly, and leave between them a triangular space. 6. The superior perineal aponeurosis, which is strong anteriorly, but weak posteriorly, and forms, between the bladder and the rectum, a cul-de-sac, the base of which, in the adult, is three inches distant from the cutaneous surface of this region. 7. A very loose cellular and adipose layer. 8. The peritoneum, which often descends between the bladder and the rectum to the prostate gland, and is sometimes half an inch distant from this body; then, only, the rectum and the bladder at its base are united by a slightly dense cellular tissue; then only, also,

is there a recto-vesical septum in a triangular space formed by the diverging of the seminal vesicles and vasa deferentia.

Development. When developed in the fetus, the perineum of the male presents no character to distinguish it from that of the female; soon after, however, the urethra forms from behind forward, by uniting in the centre, so that its perineal portion may be distinguished there, before that which belongs to the penis. This canal first appears in the form of a groove, open at the base, its upper wall being formed first. In the early periods, the bladder appears as a canal, continuous with the urethra; it has then no base; the prostate gland is slightly developed and elevated, the peritoneum descends very low between the bladder and the rectum, even in very young fetuses; it can be followed under the prostate gland and the membranous portion of the urethra, as we have seen. This arrangement, and the simultaneous absence of the base of the bladder, continue until puberty, and often beyond it; before this age, the perineum in the male is destitute of hair. The absolute thickness of the perineum increases with the age; its relative thickness, however, diminishes until puberty, excepting on the median line, where the peritoneum, rising to form the recto-vesical septum, increases, on the contrary, in this point, in the same dimension. In young subjects, the almost complete absence of the anal enlargement of the rectum, also contributes to prevent the recto-vesical septum: in very old individuals, on the contrary, this intestinal dilatation often becomes extremely large; the recto-vesical septum is then very extensive. In very young children, the bulb of the urethra is small, and remote from the rectum; it increases progressively with the age, so that in old men it advances toward the rectum, and extends very far laterally.

Varieties. The varieties of the perineum in the male, relate to its dimensions: we have already mentioned them: it is important to note the arrangement of the prostate gland at the neck of the bladder: sometimes it is situated entirely upward, and then the urethra and the neck of the bladder are very near the rectum. We know the importance of this abnormal position of the prostate gland, which has been observed several times by Senn.

Pathological and operative deductions. The urethra frequently opens at the perineum, either terminating there entirely, or continuing under the penis; this is perineal hypospadias, the formation of which is explained by the development of the region. Abscesses often form in its genito-urinary portion: they may result from infiltrations of the urine: the cellular tissue is then constantly gangrenous: these effusions of urine, either from a traumatic rupture of the urethra, from a forced introduction of the catheter, or from a violent effort to expel the

urine, may occur behind, before, or at the bulb. In the first case, which is very severe, the urine separates the bladder and the rectum, affects the prostate gland by pointing between the middle and superior aponeuroses; in the second, the urine goes forward and upward, toward the bursæ, the penis, and even the abdominal wall, following the upper face of the inferior perineal aponeurosis, which, on the other hand, opposes its infiltration toward the anus, although this part is the lowest; fistulæ, which are more or less deep, are usually the result of these ruptures; they likewise cause perineal hypospadias. In contusions of the perineum, the urethra may be crushed and broken, without any affection of the skin; we have seen several cases of this; a violent hemorrhage may result from this injury, which may be arrested by introducing a very large bougie into the passage. The prostate gland is often the seat of tumefactions of various kinds, which are perceived through the rectum, in consequence of its relations with this intestine. It becomes schirrous in old men, and then the neck of the bladder is contracted, and retention of urine ensues. Calculi sometimes form in the lacunæ of the prostate gland; they are always numerous, and of the mulberry character; we have seen an individual, where calculi of the prostate gland, after causing inflammation of the prostate gland, and its ulceration posteriorly, extended very high between the bladder and the rectum, and were contained in a pouch full of urinous and purulent liquid; the peritoneum had been very much crowded upward. Phlebolithes often form in the branches of the prostatic venous plexus. In this part of the perineum, the bladder may be punctured in two ways: first, through the rectum; second, by passing through the soft parts of the perineum. The first method, supposing that the recto-vesical septum always exists, is bad on that account; and also because it may be followed by the injury of one of the vesicles, or of the vasa deferentia, which are contiguous behind the prostate gland, and also because it is generally attended with incurable fistulæ; the second* operation is still more objectionable, even with all its modifications, because it may be followed not only with an injury of the rectum, of the spermatic vesicle, and even of the prostate gland, but we may fail to perforate the bladder, or which is still worse, we may arrive at it after wounding the peritoneum.

In this region, also, the operation of lithotomy is generally performed; to examine it anatomically, we shall admit only three methods: the median, the oblique, and the bilateral.

* It consists in puncturing the perineum with a trocar, in the centre of a line drawn between the sciatic tuberosity and the raphe, an inch before the anus: this trocar is introduced, at first, directly from below upward, and then it is advised to incline it towards the median line, to avoid the prostate gland.

The median operation is always and necessarily attended with the injury of the ejaculatory ducts, and when performed directly in the centre, it is objectionable in young subjects. If we wish to operate without cutting the rectum, the division of the neck of the bladder must be only seven lines; if, on the contrary, we wish to cut the neck of the bladder and the lowest part of the rectum, we generally make a larger opening, which is most commonly followed with incurable fistulæ. The operation, which would consist in dividing the prostate gland, the rectum above it and the recto-vesical septum, (an operation first proposed by Sanson, but which we believe is abandoned,) would be a rash attempt, rejected both by surgery and anatomy; besides the objections of the median operation, already mentioned, it is often attended with the opening of the peritoneum, especially in children, as happened to Gery, in the only case, happily, where the bladder has been so largely divided. In performing the median operation, we divide successively, the skin, the dense cellular tissue of the raphe, the inferior perineal aponeurosis, the extremities of the bulbo-cavernosus and sphincter muscles, which are separated by this latter, the raphe of the transversus perinei muscles, the middle aponeurosis, the inferior part of the bulb of the urethra, its membranous part, and the prostate gland below, with the neck of the bladder; finally, the incision comes to the verumontanum, unless we follow Dupuytren's advice, and cut a little on the side of it; but then we are liable to injure one of the ejaculatory ducts and the extremity of the spermatic vesicle; finally, on proceeding beyond the prostate gland, we also arrive at that part of the rectum which is nearest the anus, and at the sphincter.

In the lateral operation, we distinguish three periods: first, the incision of the soft parts under the urethra; second, the opening of the urethra on the catheter; third, the incision of the neck of the bladder. In the first, we divide the skin, the sub-cutaneous cellular tissue, the inferior aponeurosis, some twigs of the superficial perineal artery, which is pushed on the inside without dividing it, unless the operation be performed too much on the side; the bulbo-cavernosus and transversus perinei muscles, the bulb below, the middle aponeurosis, and the membranous portion of the urethra. We must operate fourteen lines in front of the anus, to avoid the artery of the bulb in the normal state; its injury at other times is inevitable; the inferior hemorrhoidal arteries cannot be wounded, except behind the sciatic tuberosity. In the second period, the urethra alone is divided; we cannot injure the rectum here, except by raising the handle of the bistoury too much, by which its point slips from the groove of the sound. In the third period we divide, transversely or obliquely, the neck of the bladder, the prostate gland, and the anterior fasciculus of the levator ani muscle.

In order not to proceed beyond the prostate gland, the incision should be only nine or ten lines ; beyond this, we wound the prostatic plexus, and the urine infiltrates more easily ; we may injure the rectum, if it be much enlarged, and we may even cut the corresponding seminal vesicle : finally, if the incision is made crosswise and broadly, beyond the prostate gland, we divide the superior perineal aponeurosis, which rests on the sides of this organ, and consequently the infiltration under the peritoneum and the severest symptoms supervene rapidly. We must proceed beyond the bounds prescribed by the operation to wound the trunk of the perineal artery, which is situated out of the region, and is protected by the bones and the fibrous parts. In case this accident should happen, the hemorrhage can be arrested by tying the artery on the inside of the sciatic tuberosity, where it may be easily exposed, and a ligature can be applied by means of a curved needle, or it may be stopped by a stitch of the twisted suture, as was done by Dr. Physic, of Philadelphia. Post mortem examination has generally shown, that where severe hemorrhage had led to the suspicion that the internal pudic artery was wounded, this vessel was uninjured, and one of its branches, generally the transverse, has been divided. Beclard has also made some experiments upon the cadaver, from whence it results, that it is almost impossible, in operating for stone, to open the pudic artery, even when we attempt it by making a large incision. In describing the perineum generally, we have mentioned the variety where the obturator artery sends a branch towards the penis, under the symphysis pubis ; in this case, Shaw thinks that the vessel may be wounded in the lateral operation ; this conclusion should not be generally adopted.

The bilateral operation, the advantage of which is to obtain a broad opening within the prostate gland, requires the division of the skin, the sub-cutaneous cellular tissue, the inferior aponeurosis, the bulbo-cavernosus, the sphincter and transversus perinei muscles, the middle perineal aponeurosis, the levator ani muscle, the lower part of the bulb, the membranous part of the urethra, the neck of the bladder, and the prostate gland transversely, or by two incisions, which are more advantageous according to Senn ; one oblique on the left, the other transverse on the right. Farther, we must also remember, that the transverse extent is nineteen lines only. By the curved direction of the external incision, we generally avoid the injuries of the superficial perineal arteries and those of the bulb, on the inside of which the operation is performed. The perineal portion of the urethra being the only part which presents a curve, with alternate dilatations and contractions, it is curious to examine it for the introduction of the catheter. When the canal is open, on account of its dilatability, catheterism is

always performed easily, whatever may be the direction of the sound; but it is evident, that an instrument curved like the urethra, if properly directed, does not rub at its point, and that the contrary is true if the instrument is straight, since it is impossible for the passage to assume this direction. Hence, in difficult catheterism, with a bougie more or less pointed, it is better for this to be curved; a straight catheter would be more liable to make a false passage, especially if we remember that its beak, rubbing against the lower wall, can easily enter the lacunæ of Morgagni, which are there very numerous. If we add to this, that in order to sound in this manner, the penis should be drawn forward, in which position, as we have seen, the urethra is relaxed to the perineum, whatever force may be exercised on it, and also in this position some folds form on the lower wall which impede it, we shall soon see that the rotatory movement which the use of these sounds admits, would in fact facilitate still more the formation of false passages. Farther, in order to introduce the sound, we must turn the beak of the sound according to the curve of the urethra, on which its direction should be moulded; we may also place the finger under the scrotum or in the rectum, to keep the tip of the instrument on the median line. In difficult cases, we must avoid drawing the penis on the sound, in order to be able to seize this lower, act by the shorter arm of the lever, and be more sure of keeping the tip of the instrument in place.

2 PERINEUM IN THE FEMALE.

The perineum of the female presents a surface which is extended in a measure at the expense of its height. The antero-posterior and transverse diameters, are each four inches: the first may be enlarged by pushing back the coccyx. Anteriorly, under the symphysis, the perineum in the female also presents a transverse extent of an inch, differing thus from the perineum in the male, which terminates there in a point.

The height between the mucous face of the vestibule and the anterior face of the bladder, was found to vary, in twenty subjects, from ten to fifteen lines; included between the meatus urinarius and the cul-de-sac of the peritoneum, behind the bladder, it was from two to three inches.

The perineum in the female presents two faces, one peritoneal, the other cutaneous. The first is bounded by the bladder, the vagina, and the rectum, and presents two depressions; one, between the bladder and the vagina, the second, between this latter and the rectum; these depressions vary in depth. On the second face, from behind forward,

we remark the anus, situated behind the bisciatic line, and the lower extremity of the vagina, which is expanded to form the vulva. This latter part is bounded on the sides by the external labia, which are united anteriorly and posteriorly by a commissure, the outer face of which is cutaneous and hairy, while the internal is mucous and smooth: on the inside of these labia, the nymphæ or internal labia appear anteriorly, united on the back of the erectile organ, the clitoris, a kind of penis which is destitute of a urethra and is covered by a special prepuce; below this body, between the internal labia, is a triangular surface, bounded posteriorly by the meatus urinarius, this is the vestibule; below, the meatus urinarius, which presents a very marked prominence, an arrangement which serves as a guide in catheterism, when the genital organs are not exposed. The opening of the vagina is situated below; in virgins, it is more or less contracted, and closed in a certain extent by the hymen; in married women, however, it presents, on the contrary, the carunculæ myrtiformes.

Structure.—1. *Elements.* We find here all the elements of the general structure of the perineum, as has been mentioned, which elements, however, are less developed. The ano-cavernosus muscle is divided into two parts, and embraces the lower extremity of the vagina, and hence it is termed the sphincter vaginæ muscle; the vessels and nerves present only this peculiarity, namely, that their lower or superficial perineal branches, are larger than the superior. The inferior aponeurosis is divided by the vagina into two lateral segments; the central also presents for it a broad opening; the superior forms in this region two feeble anterior ligaments, which may be called the pubio-vesical, the existence of which has been denied by some authors, but wrongly. The urethra presents remarkable differences; it terminates in the region; it is not surrounded by a prostate gland, and does not turn, like that in the male, around the inferior and anterior part of the symphysis; it is directed obliquely downward and forward, toward the interval between the roots of the clitoris, it is very sloping on the side of the bladder, is very dilatable in all its parts, and its mean length is one inch. The bladder corresponds to the anterior part of the perineum, its anterior face is covered by the symphysis pubis, which is about an inch high. The vagina forms the only true special organ; it passes through the perineum in the female, following a slight curve; by its size, it occupies a considerable space, and crowds the rectum and the anus some distance backward.

2. *Relations.* The relations of the rectal portion of the perineum in the female need not be mentioned here; they present nothing special; we shall only speak of those of the genito-urinary portion, which

we shall study, first at the vestibule, second, on the side of the vagina, third, between this and the rectum.

1. *Vestibule.* This portion is formed, proceeding from the outside to the inside, by the following layers; the mucous membrane, a semi-erectile cellular tissue, a very thin inferior perineal aponeurosis, and under it the end of the superficial vessels and nerves of the perineum, the anterior portion of the urethra, which is intimately united to the vagina, the anterior extremity of the sphincter vaginæ muscle, the ischio-cavernosi muscles, and the roots of the clitoris, the middle perineal aponeurosis traversed by the urethra, and containing between its layers the transverse artery, which proceeds from without inward, at the meatus urinarius. Between the middle and the superior aponeurosis we find, on the sides, the levator ani muscle, in the centre, a dense cellular layer, which takes the place of the prostate gland, around which is a net-work formed by the dorsal veins of the clitoris and those of the bladder, the first passing through the middle aponeurosis under the symphysis pubis; next comes the superior perineal aponeurosis, united, by a loose cellular layer, with the anterior part of the neck and of the body of the bladder; at this part also, the base of this latter organ blends with the vagina, and forms the vesico-vaginal septum.

2. *Lateral relations of the vagina.* Under the skin and the mucous membrane, which unite and form the external labia, while the internal are constituted simply by a mucous fold, we find; a loose cellulo-vascular layer, analogous to that of the dartos, the inferior perineal aponeurosis, which is stronger here than anteriorly, under it the superficial perineal vessels and nerves, the corresponding fasciculus of the sphincter vaginæ muscle, the most distant part of the corresponding root of the corpus cavernosum of the clitoris and the ischio-cavernosus muscle, the middle perineal aponeurosis, the levator ani muscle, the loose sub-peritoneal tissue, and the peritoneum.

3. *The ano-vaginal portion, the perineum of some writers.* From the peritoneum to the skin, the organs of this portion of the perineum are situated in a triangular space, the base of which is at the skin, while one of the edges is formed by the vagina, the other by the rectum, and the summit which looks upward, results from the union of these two organs, and forms the recto-vaginal septum; the organs there present themselves from without inward in the following relations; the skin, the anterior extremity of the sphincter ani attached below the inferior aponeurosis of the perineum, this aponeurosis itself, the posterior extremity of the sphincter vaginæ inserted above this latter, the transversus perinei muscle, the middle perineal aponeurosis, a dense cellular tissue which unites the rectum and vagina, and finally, the posterior depression of the peritoneum.

Development. In the early development, the perineum of the female is remarkable for the size of the clitoris, which assimilates this region to that of the male, considered when the urethra is not formed under the erectile organ. Farther, the nymphæ are very long and extended under the clitoris, and then resemble the urethra of the male. Until puberty, the perineum of the female is contracted transversely, and its height seems to increase there; the peritoneal depressions are deeper; after this age it assumes the characters indicated as types.

Varieties. The deviations in the formation of the outlet of the pelvis also cause in the perineum of the female frequent individual varieties.

Pathological and operative deductions. The manner in which the perineum is developed explains admirably the absence of the vagina, its obliteration by a simple membrane, the obliteration of the urethra, or the abnormal union of the digestive and genito-urinary organs in one cavity, a kind of cloaca similar to that of birds, reptiles, and fishes; finally, the enormous development of the clitoris in female hermaphrodites, which resembles the penis. The direct relations of the bladder and of the rectum with the vagina, account for those disgusting communications between the canals of the perineum, caused by ulcerations of different characters. Perineal hernias occur more frequently here on account of the thinness of the region, and particularly on account of the debility which results from repeated pregnancies. The relaxed parietes of the vagina sometimes yield and form pouches, into which the abdominal organs descend, (vaginal hernias.) Diseases of the anus are less frequent in the female than in the male, because the parts are less developed. The sub-pubic operation of lithotomy is performed by dividing the anterior portion of the perineum in the female, the vestibule. The incisions made for this purpose may be referred, as in the male, to three directions; the median, the lateral, and finally the bilateral.

The first mode of incision comprises the method of Dubois and the vesico-vaginal method; sometimes in this latter, the vesico-vaginal septum alone is divided, as seems to have been done by Rousset and Fabricius; sometimes, on the contrary, according to the advice of Vacca, we divide the urethra, the neck of the bladder, and the corresponding part of the vagina; in Dubois' method we divide successively; the mucous membrane, the inferior aponeurosis, some small vessels, the middle aponeurosis, the superior wall of the urethra, the neck of the bladder with the vascular net-work which surrounds it, and the superior perineal aponeurosis. The shortness of the canal of the wound, and particularly the facility with which the urine escapes, indicate sufficiently the safety of this method, in which we should not

approach too near to the symphysis, in order to avoid the clitoris and its vessels. In the operation through the vagina, we are exposed, when we wish to divide the vesico-vaginal septum, to cut the peritoneum, and in all cases to leave vaginal fistulæ.

The second mode of incision of the neck of the bladder and of the vestibule, constitutes the lateral operation in the female, a method in which we cut the mucous membrane, the inferior aponeurosis, the anterior extremity of the bulbo-cavernosus, the transversus perinei, the middle aponeurosis, the anterior part of the levator, the urethra obliquely backward, the neck of the bladder, and its venous net-work. We must proceed beyond the vestibule to open the transverse artery; the superficial is situated too far on the outside to be wounded.

The third mode of incision comprises the double division of the neck of the bladder and of the urethra, as has been proposed by Louis and performed by Flurant, who has invented for this purpose a double lithotome. The vestibule is also divided bilaterally, in the method mentioned by Celsus, and also in that of Lisfranc, which consists in arriving on the anterior wall of the bladder, by dividing the vestibule in such a manner, that the curve embraces the urethra, but does not touch it; the other parts which are divided in this operation are the same as in the lateral operation. Lisfranc thinks that we can thus prevent in females that incontinence of urine, which is so common after the other modes of operating.

ORDER SECOND.

CIRCUMFERENCE OF THE PELVIS.

The circumference of the cavity of the pelvis forms, at the lower part of the abdomen, a resisting surface, on the outside of which the lower extremities are supported, and which sustains posteriorly the weight of the body. This great region, the limits of which are well marked upward and downward, has, for its skeleton, the sacrum and the coccyx posteriorly, the iliac bones on the sides and anteriorly. It is also formed by some fibrous parts, the obturator membrane imperfect above, the sacro-sciatic ligaments, not to mention the ligaments of the symphysis pubis. The soft parts are situated inside and outside of the skeleton, forming, in fact, two planes or secondary regions, the intra-pelvic, and the extra-pelvic.

The circumference of the pelvis, considered generally, participates in the development of the perineum and of the abdomen, by two lateral pieces, which serves perfectly to explain its principal deviations, such as its division anteriorly, in extrophy of the bladder, and poste-

riorly, in spina bifida. In the male, the height of this part of the abdominal parietes is developed particularly; its breadth predominates in the female.

1. INTRA-PELVIC PORTION.

This part of the circumference of the pelvis forms a single region, called the intra-pelvic. It terminates at the margin of the pelvis, and presents a peritoneal face, undivided in the male, separated in the female into two parts, an anterior and a posterior, by the broad ligaments of the uterus.

Structure.—1. *Elements.* Many parts which we have studied in the perineum extend here by curving upward; these are the peritoneum, the superior perineal aponeurosis, which deserves in this point the term fascia pelvia, given by some authors, particularly Cloquet, the levator ani muscle and its inferior aponeurosis posteriorly; we also find in this region the obturator internus, pyramidalis, and ischio-coccygœus muscles, an aponeurosis which forms the sheath of the obturator internus muscle. This latter is situated on the limits of the perineum, arises from the external face of the middle perineal aponeurosis, descends perpendicularly on the inner face of the obturator internus, and terminates on the falciform edge of the great sacro-sciatic ligament; it is very strong inferiorly, where it encloses between two layers, the trunks of the pudic vessels and nerves posteriorly, and their superior branches anteriorly; it constitutes the outside of a fibrous cavity, filled with cellular tissue in the anal region. The hypogastric artery and all its branches, at their origin, belong to this region, with their attendant veins, and also many lymphatic ganglions, which are termed the pelvic ganglions, which receive, not only the lymphatic vessels of the region, but also those of the deep part of the perineum, of the buttock, of the posterior part of the thigh and of the pelvis. On issuing from the sacral foramina, the anterior branches of the sacral nerves are situated in the pelvis, send to it some twigs, and form by their angular union the sacral plexus, which is united to the lumbar plexus by the lumbo-sacral nerve; we also find there the last portion of the tri-splanchnic nerve and their ganglion of union, the coccygœal, some very loose cellular and adipose tissue, and separated by some aponeuroses from those of the perineum, but communicating with those of the thigh and the buttock, through the sub-pubic and ischiatic openings.

2. *Relations.* The arrangement of these parts, from the peritoneum toward the bones, is as follows: anteriorly, on the median line, the

body of the bladder, in relation by its anterior face, and united with the bodies of the pubis, and with their prominent symphysis, on this side, by a loose cellular layer; always anteriorly, but on the right and left of the median line, we find the peritoneum, a lamellar cellular layer, the pelvic aponeurosis, and the obturator internus muscle, above; below, on the contrary, the peritoneum, the pelvic aponeurosis, the levator ani muscle, the angle of separation of the middle aponeurosis of the perineum, and of that of the obturator muscle, this last including between its layers the pudic vessels and nerves, which rest against the bones; finally, the obturator muscle, which is very thick in this point. At this height is situated the sub-pubic ring, formed above by the horizontal ramus of the pubis, below by the pelvic aponeurosis, an opening which encloses the obturator vessels and nerves, which rest against its outer side. On the sides of this intra-pelvic region, and superiorly, we find the peritoneum, a loose cellular layer, in which the obturator vessels and nerves glide from behind forward, the pelvic aponeurosis, the obturator internus muscle, and also the sciatic foramen, formed by the pelvic aponeurosis below, and the great sciatic notch above, through which ring pass the gluteal vessels; below, we find the levator ani muscle, its inferior aponeurosis, the fibrous angle of the anal portion of the perineum, the aponeurosis of the obturator muscle, with the pudic vessels and nerves, and the obturator muscle. Finally, at the posterior part of the intra-pelvic region, under the peritoneum, which is deficient at the rectum, are a cellular and an adipose layer, which contain the hemorrhoidal, vaginal, and vesical vessels; the venous, lymphatic, and nervous hypogastric plexuses; the pelvic artery and vein, situated on the side before the sacro-iliac symphysis; the pelvic aponeurosis, blended with the periosteum of the sacrum; the great sympathetic nerve and the sacral plexus, the pyramidalis and ischio-coccygœus muscles, surrounded by a loose cellular tissue.

Varieties. The obturator artery sometimes comes from a trunk in common with the epigastric artery, or from the external iliac artery: it is then situated in front of the region, behind the ramus of the pubis, at the upper part of the sub-pubic ring. This artery sometimes sends off obliquely, under the symphysis, a considerable branch.

Pathological and operative deductions. The lymphatic ganglions of the pelvis engorge in diseases of the pelvic organs, and also in those situated deeply in the perineum, in the buttock, and in the posterior part of the thigh; some purulent and sanguineous collections pass into it from below upward, through the sub-pubic and sciatic foramina, in the purulent or sanguineous sub-aponeurotic effusions of the pelvic extremity. We have verified these assertions in two individuals, at

the Hospital La Charité, in whom the thigh was amputated; in one, the blood had penetrated into the pelvis, through the great sciatic fissure; in the other, pus had arrived there through the same point, and through the sub-pubic ring. Congested abscesses of the sacrum anteriorly, and even those of the loins, have sometimes pointed at the thigh, through the sub-pubic ring; from this point, the pains of sciatic neuralgia extend. Hernias may occur through the sub-pubic and sciatic rings; they may even be strangulated there: the position of the sub-pubic vessels, on the outside of the sub-pubic ring, that on the inside and above, assumed by these vessels when they come from a trunk in common with the epigastric artery, shows that the inner and inferior part is that on which we must operate. On the upper boundary of this region, Dr. Stevens has tied the hypogastric artery, in a case of gluteal aneurism.

2. EXTRA-PELVIC PORTION.

This part of the circumference of the pelvis blends on the sides with the pelvic limbs, of which it forms the first section; we shall mention it in another place; posteriorly and anteriorly it is loose, and constitutes the posterior sacral and pubic regions, at the same time that it supports in the male the external genital organs and the regions which they form.

1. POSTERIOR SACRAL REGION.

The posterior sacral region is continuous above with the lumbar portion of the spinal face of the trunk; below, it extends to the perineum; laterally, it is bounded by the posterior prominence of the ilium. Its outer face is depressed in the centre, and presents the raphe: the bones there are easily felt, particularly below.

Structure.—1. *Elements.* The elements of this part are few in number; they rest on the sacrum, the coccyx, and the iliac bones, which unite and form two grooves, separated by the median crest: among the numerous ligaments which unite them, it is important to remember the posterior sacro-coccygœal ligament, which closes the terminating groove at the bottom of the sacral canal, and under which the arachnoid membrane of the spinal marrow, and the cavity which it forms, extend. The mass of the sacro-lumbalis and longissimus dorsi, and the semi-spinalis dorsi muscles, begin in this point, where we also find the inferior aponeurosis of the latissimus dorsi muscle,

and some fibres of the glutæus maximus muscle. The skin presents nothing peculiar; the arteries leave the sacral canal, they come from the lateral sacral arteries, and anastomose with the lumbar: the veins go into the vertebral sinuses; the superficial lymphatic vessels belong to the inguinal ganglions; the deep, to the pelvic ganglions: the nerves come through the posterior sacral foramina, and are the posterior branches of the sacral nerves; the cellular tissue is loose, and in small quantity under the muscles; it is more dense on the outside, particularly on the median line; the sacral canal corresponds to this region, and the principal nerves of the lower extremity come from it through the anterior and posterior sacral foramina, which are situated on the same level.

2. *Relations.* The skin in the centre is doubled by a dense cellular tissue, which attaches it intimately to the crest of the sacrum and to the coccyx; more deeply, we find, successively, the aponeurosis of the latissimus dorsi, from which arise some fibres of the glutæus maximus, the very strong aponeurosis of the sacro-spinalis, the fleshy portion of this latter muscle and the sacrum; the skin and the coccyx are separated only by some cellular tissue and by some fibrous productions. The arteries proceed from before backward to the skin; they are but of little importance.

Pathological and operative deductions. From our statements, it follows, that in falling on the buttock, the coccyx may be easily fractured, if it be fused with the sacrum; this latter, also, must be very much jarred, as likewise the nerves which it protects, which may give rise to a more or less perfect paralysis of the extremities, the bladder, and the rectum. The sacrum is rarely fractured in these falls, as the iliac bones in fact support the shock, because they project much more posteriorly. A wounding instrument, directed from below upward, might enter at the lower part into the sacral canal, which is protected in this point only by the skin and the posterior sacro-coccygœal ligament; the breadth of the posterior sacral foramina above, their correspondence with the anterior, shows the possibility of injuring the organs in the cavity of the pelvis, by a stylet carried from behind forward in this region, without producing a fracture of the sacrum. Beclard mentioned a remarkable instance of this in his course, where the bladder was affected in this manner. Enormous eschars often appear here, in diseases of long standing; when they slough off, the sacrum and the coccyx may be denuded and affected. In these cases, we have twice seen the cavity of the arachnoid membrane opened: this fact is very important, as it accounts, to a certain extent, for the severe and rapidly fatal symptoms which mark the last period of many adynamic fevers, complicated with eschars in this region.

2. PUBIC REGION.

The pubic region is very simple ; it is convex anteriorly, particularly in the female, and at puberty is covered with hair ; it is bounded on the outside by the spines of the pubis, above and below by the upper and lower edges of the symphysis.

Structure.—1. *Elements.* The body of the pubis serves as a point of support to this region ; it forms there the symphysis pubis, before which many fibrous parts terminate. The first adductor muscles and the rectus internus, commence here, and also the rectus abdominis and pyramidalis ; but all of these belong but slightly to the region of which we are speaking ; in the female, the round ligament passes through it, and terminates here ; in the male, the spermatic cord merely passes through it. Its arteries come from the external pudic arteries ; the veins correspond to them very exactly ; the lymphatics go to the inguinal ganglions ; the nerves come from the lumbar plexus, and particularly from the ilio-scrotal or vulvar and the genito-crural branches. The cellular and adipose tissues are very abundant here.

2. *Relations.* The skin, the cellulo-fatty layer in which the vessels and nerves are situated, the spermatic or sub-pubic cords on the outside, the pubes and their symphyses, are the layers of this portion of the pelvis.

Development. In very young female fetuses, we find in this region, along the round ligament, a prolongation of the peritoneum, which is afterwards obliterated, the canal of Nuck. In male fetuses, until birth, we find on the spermatic cord, the unobliterated neck of the vaginal tunic.

Pathological and operative deductions. In this place, we make the incision in symphysiotomy according to Sigault's method, in order to obtain a slight separation of the bones, and thus produce artificially in the female what occurs naturally in certain animals,* from the great extension of the fibrous substances of the symphysis. Encysted tumors often appear in this region, and particularly in females ; in them they are sometimes the remnants of the canal of Nuck.

* In the family of the rodentia, and particularly in the capybara.

3. EXTERNAL GENITAL ORGANS.

The external genital organs are attached to the pubic region of the perineum, and also to the anterior wall of the abdomen; the regions which they form, although peculiar to the male, have their analogies in the female, although in her they are in a measure rudimentary, and are confined to the perineum, where we have considered them. These regions are those of the testicles and of the penis.

1. TESTICULAR OR SCROTAL REGION.

This region is continuous posteriorly with the perineum, but the separation is not very distinct, and anteriorly with the pubic region; it is separated from the thigh by a groove, in which numerous cutaneous follicles are situated.

Its surface is more or less extensive, the median raphe is there very distinct, and divides it into two lateral portions, of which the left always descends lower than the right;* in young and strong subjects, we perceive some very distinct transverse wrinkles, some hairs which are continuous with those of the pubis and perineum; these are the other external characters of this part of the body.

On the right and left of the raphe is a serous cavity; it is entirely distinct in the normal state, and contains only a thin serous vapor; the testicle and epidydimis cause it to project posteriorly.

Structure.—1. *Elements.* This region presents no osseous part, resembling in this respect the abdominal region, of which it is evidently a prolongation, and of which it has the structure. We find, also, the skin which constitutes the scrotum, the dartos, a cellular fibrous layer, which is continuous with the fascia superficialis, is attached to the branch of the ischium, and resting on the median line, against that of the opposite side, forms a true septum, a fibrous expansion which is detached from the edge of the inguinal ring, and which cannot be traced beyond the cord, the cremaster muscle, composed of fibres of the obliquus internus and transversalis muscles, and which presents two fasciculi, an external, which is the larger, and an internal. The cremaster exists only before the cord; although some of its fibres may

* This difference has been attributed to the left lateral curve of the trunk and of the dorsal region; we think that it depends much more on the habitually greater dilatation of the testicular veins on this side; this dilatation is produced by the pressure of the sigmoid flexure of the colon, which causes the weight of a greater column of blood on the left testicle, and this is consequently depressed.

also be found behind it; farther, the fibres of the cremaster muscle, as Cloquet has demonstrated, describe plexuses, concave superiorly; we find also in this region, the fibrous sheath common to the testicle and the cord, a kind of pyriform sack, continuous in the inguinal canal with the infundibulum of the fascia transversalis, and finally the vaginal tunic, which forms the parietes of the serous cavity, envelopes the testicle only anteriorly, extending a little before the cord, and uniting above to the peritoneum, which passes on the upper orifice of the inguinal canal, by a cellular cord, the remnant of the obliterated neck of the vaginal tunic. These different layers receive some arteries from the crural artery, (the external genital) and from the superficial perineal artery, which forms the artery of the septum; their veins are very broad and numerous, and accompany the arteries; their lymphatics go to the superficial inguinal ganglions. The nerves come from the lumbar plexus, and particularly from the ilio-scrotal and genito-crural branches; the small sciatic nerve from the sacral plexus terminates there also; the cellular tissue is very loose, and contains no adipose vesicles inferiorly; some are found superiorly; finally, the testicle and its cord occupy the centre of this region. The description of these latter organs belongs to descriptive anatomy; we will only mention, that the spermatic cord is formed by the peritoneo-vaginal cellular ligament, which has been mentioned, by the arteries and nerves which go to the testicle, and by the excretory ducts and veins which leave it; all these parts are united by a loose cellular tissue, in the centre of which, adipose masses are sometimes developed superiorly. The artery of the testicle comes from the aorta at a very acute angle, and sometimes from the renal artery; it is covered by the plexus of the testicular nerves given off by the great sympathetic nerve; the veins of the testicle are at first numerous, and then unite in one trunk; after this, they separate and anastomose to form the pampiniform body, and again unite to go to the vena cava, or the renal vein, particularly on the left; these veins inferiorly have no valves; they are very broad, on the left particularly, where they pass into the belly, behind the sigmoid flexure of the colon; the lymphatics of the testicle go to the lumbar ganglions.

2. *Relations.* The relations of this region are extremely simple; they must be studied around the testicle and its cord, considered as a centre. The skin forms the first layer; then come successively; the semi-contractile tissue of the dartos, in which are situated the external genital vessels and the superficial perineal artery, an expansion detached from the inguinal ring, the cremaster muscle, which is generally deficient posteriorly, the sheath common to the cord and the testicle,

the vaginal tunic situated below, before the testicle and the adjacent part of the cord, and finally these two parts.

Development. At first this region is entirely deficient; but it soon appears on each side of a deep groove which exists in the perineum in the early periods. It is not well developed until the testicles have come into it; before this period there is no cremaster muscle; this muscle forms when the testicle passes under the obliquus internus and transversalis, the lower fibres of which it draws down; then, also, are formed, the vaginal tunic, the dartos, and the common sheath of the cord and testicle, by the depression of the peritoneum, and of the fascia superficialis and transversalis. At first, the vaginal tunic communicates with the peritoneum, by a passage which forms its neck; this is contracted shortly after birth, and thus changes into a cellular cord; sometimes this is obliterated only in certain points, and it remains open in others.

Varieties. In some individuals the testicles do not descend, and the changes we have mentioned do not occur, until very late; in others, the communication of the vaginal tunic with the peritoneum remains for a long time, and even during existence. It has been stated that one testicle, or both, are sometimes deficient. In these cases, the testicles have most generally remained abnormally in the abdomen. In one case, however, we have found but one testicle in this region, and after examining carefully, we could find none in the abdomen, nor was there any trace of the cord, the vas deferens, or of the corresponding vesicle on this side; there was no incision on the scrotum.

Pathological and operative deductions. This region is cleft in some monstrous fetuses; a vestige of the primitive development has often led to errors in regard to the sex, particularly if the testicles continue in the abdomen. Wounds in this region are remarkable for their progress; there is always an excess of skin; the latter, on account of its flaccidity, always turns inward; its bloody edge comes in contact with the base of the wound, and not with the edge of the opposite lip; hence a cicatrix which is always slow in forming, and is always depressed in a groove. In this region inguinal hernias are situated; in the female, they descend into the external labium; the different layers which we have mentioned, develop themselves in proportion to the duration of these diseases, and hence they sometimes cannot be perceived. External hernia is enveloped with all the layers external to the cord and testicle, and also by the peritoneum of the sack; the envelope of the internal hernia is less by the cremaster muscle and the common sheath coming from the fascia transversalis; the first hernia glides before the cord, the second, a little on the inside and behind it; nevertheless, these relations of the hernias with the spermatic cord are

transitory in those which are chronic, and consequently cannot serve as a guide in dividing the ring. When the tumor which forms a hernia is large, it weighs upon the testicle and wastes it; varices of the spermatic cord have the same effect on this organ; these varices are frequent; the absence of the valves in the veins of the testicles, their successive division and union, the looseness of the layers which cover them, explain this frequency on the two sides, but the relations of the sigmoid flexure of the colon, with the veins of the left testicle, is the true cause of the more common appearance of varicocele on the left side. The continuity of the dartos with the middle cellular tissue of the perineum, explains the urinary abscesses which always occur there in ruptures of the urethra. Hydrocele, a disease of this region, may affect the vaginal tunic, or the cord; we do not allude to that caused by the infiltration of the dartos. The first extends before the cord and testicle, which are situated at the posterior part of the tumor; hence, when we puncture it, we must introduce the trocar forward, and direct it upward, in order to run less risk of injuring these parts. Hydrocele of the cord is often situated in an old herniary sac, the neck of which is obliterated, in a cyst formed accidentally, or in one or more of these sacs, which frequently remain on the neck of the tunica vaginalis. The non-obliteration of the neck of the vaginal tunic explains the phenomena of congenital hydrocele and those of congenital hernia. This latter is often produced by the testicle adhering to the intestine before its descent; the latter is then necessarily brought down with it, when it passes through the inguinal canal. Various swellings of the testicles cause peculiar pains connected with the nerves received by the diseased organ; their extirpation, which is sometimes required, presents nothing peculiar, except the facility with which it is performed, on account of the looseness of the surrounding cellular tissue. Before proceeding to this operation, we must examine the abdominal region, to discover the state of the lumbar ganglions, because as they receive the lymphatic vessels of the testicles, these ganglions may participate in their disease, which would contra-indicate an operation. Tubercles are frequently situated in the epidydimis, and also in the testicle, but less frequently; these are confounded with sarcocele, and may perhaps be cured, although slowly, without mutilation.

2. REGION OF THE PENIS.

The penis, which forms this region, is described minutely in works on descriptive anatomy. We shall merely mention, that it is attached by its upper part in front of the symphysis pubis, and that along its in-

ferior face, is a prominence which belongs to the urethra, that its root is trifurcated and enters into the perineum, that its loose extremity is rounded and formed by the glans, the point of which presents the meatus urinarius, the contracted opening of the urethra, that the glans is lower posteriorly, where it presents a groove which serves for the insertion of the frenum of the prepuce, that this envelope itself is attached to the glans by the frenum, it is mucous on the inside and cutaneous on the outside, and presents an opening, which generally gives passage to the glans, and is separated from this below by a groove, where are found glands which secrete a very odoriferous matter.* The rounded form, the size, the length, the curved direction of this organ, must not be mentioned here.

Structure.—1. *Elements.* This region is formed essentially by the cavernous body, which presents inferiorly a groove, in which the urethra is situated: the elastic membrane which confines the cavernous body, presents superiorly a small sheath for the dorsal artery and nerve of the penis. The urethra extends through the whole spongy portion of the penis; it is about seven inches long, and is dilated below the glans to form the navicular fossa; the spongy tissue, which doubles on the outside of the mucous membrane of this passage, becomes very abundant anteriorly, where it forms the glans. The arteries of this region are numerous; they come from the superficial and deep branches of the perineal, and also from the crural artery; the first form the urethral branches and terminate the artery of the septum of the dartos; the second form the deep and dorsal branches of the cavernous body; finally, the last, which are two on each side, are small, and terminate the external genital arteries. The veins of the region follow the course of the arteries; but on the outside of this point the dorsal veins leave their attendant arteries to pass under the symphysis pubis; the dorsal veins differ from the arteries, as they are not situated in the membrane of the cavernous body. The superficial lymphatic vessels, and those of the urethra, go to the inguinal ganglions; the deep to those of the pelvis. The nerves come from the superior and inferior branches of the perineal nerve. The sub-cutaneous cellular tissue is loose, that which unites the urethra and the cavernous body is very dense; the fat is entirely deficient; the skin is remarkable for its fineness, and is destitute of hairs.

2. *Relations.* The relations are very simple. Under the skin, we find, first, a loose cellular tissue, in which ramify the veins, the superficial lymphatic vessels, the inferior nerves and their lateral arteries; second, more deeply, the urethra below; third, between this canal and

* This matter is secreted very abundantly and in the same place by a small animal of the family of the cervi, and constitutes musk.

the cavernous body, the arterial branches of the urethra, situated in the membrane of the cavernous body above, the dorsal arteries and nerves; and in its centre, on the right and left of the median septum, the deep artery.

Development. This region is formed of two lateral pieces, which are very distinct; at this period, the penis is double, as in serpents. This separation continues but for a short time; the parts soon begin to unite from behind forward, and from the dorsal toward the inferior face; a law of evolution, which is very important, and which had been overlooked in regard to the cavernous body, although observed in the urethra.

Varieties. This region presents numerous individual varieties in respect to extent and volume: we shall mention here only those which affect some of its parts, which variations may be considered as deviations in development. Sometimes one dorsal artery appears, formed by the anastomosis of the two which commonly exist: we often see a branch, which leaves the pelvis, under the symphysis pubis, and anastomoses with the dorsal artery, or forms it entirely; it comes from the obturator artery: this variety assimilates the arteries to the veins.

Pathological and operative deductions. The region of the penis may be arrested in its development, and be more or less completely cleft: the urethra may be deficient, or terminate in the centre of the region by a superior opening, which is rare, (*epispadias*,) or through an inferior opening, which is more frequent, (*hypospadias*.) The development of the penis explains sufficiently the rarity and frequency of these defects in the union, considered in its back or superior surface. The penis may remain in the rudimentary state without an urethra, and resemble the clitoris: on the other hand, the median union may be perfect too, the urethra may be closed by a membrane: the opening of the prepuce also may be obliterated, or simply too narrow: this is *congenital phymosis*, which prevents the cares required by cleanliness, and thereby disposes to cancer of the penis: this anomaly requires an operation: the frenum of the penis may be too long or too short, and in both cases it must be divided. Sometimes this region is amputated: Dupuytren, in a very remarkable case, has removed it to the perineum: from what has been said, we can readily conceive that eight or ten arteries must be tied in this operation; the two deep cavernous arteries, two dorsal, two small inferior urethral, and some lateral twigs given off by the external genital arteries. The necessary collapse of the erectile body, explains the precept given by authors, to remove the skin largely in amputations of the penis. In blenorrhagia, anatomy and experience demonstrate, that the ganglions in the groin may be affected sympathetically.

ARTICLE II

ABDOMINAL CAVITY.

The regions which have been described circumscribe a cavity, which contains most of the digestive tube, and of the urinary and genital organs; it is the *abdominal* cavity, the largest of the splanchnic cavities.

This cavity is oval; its direction varies at different points: in the supra-pelvic portion, its axis is directed from above downward, from behind forward, and a little from left to right, and would be represented by a line drawn from the centre of the diaphragm towards the right pubic spine, an oblique direction, which depends on that of the diaphragmatic region, which is itself caused by the base of the thorax and the dorsal portion of the spine. The direction of the pelvic portion of the abdominal cavity, is a curve, concentric to the anterior face of the sacrum; and, in fine, the direction of the whole abdominal cavity is that of an S: we shall mention, hereafter, the effect of this double curve on some of the functions.

The limits of the lower part of the abdomen are distinct; this, however, is not the case above, as may be seen by a bare inspection. This cavity is interlaced, in some measure, with that of the thorax, so that the former, on the inside, rises much above the place where the second descends on the outside; this arrangement varies according to the motions of the wall of the diaphragm in respiration; generally speaking, in the deepest inspiration, the abdominal cavity ascends as high as the eighth dorsal vertebra, consequently much above the lower limits of the pulmonary cavities. The abdominal cavity rises a little higher on the right than on the left.

Contained parts. We shall consider, as belonging to this cavity, only the organs which are entirely detached from its parietes; these are, first, the different parts of the digestive tube, from the end of the esophagus to the termination of the rectum; second, the kidneys, ureters, and bladder; third, the uterus and its appendages in the female, the vasa deferentia and vesiculæ seminales in the male: all these parts are minutely described in works on splanchnology, so that we shall only mention their relations: all are covered more or less perfectly by the peritoneum, the arrangement of which also belongs to descriptive anatomy; we, however, shall briefly recapitulate it, on

account of its extreme importance, and because it is not generally mentioned methodically. We shall at first state this fact, that, if we except the bladder, no viscus rests against the anterior and lateral parietes of the abdominal cavity: the serous membrane, also, passes there very simply, only with the various adhesions which have been mentioned: all the abdominal organs, on the contrary, rest against the posterior, superior, and inferior parietes, to which they are united by vessels and cellular bands, which form the proper pedicle of each of them: these are the points on which the peritoneum is reflected so many times, leaving the parietes to go on the organs, and enveloping them in an extent which varies according to the extent of the surface, by which these give insertion to their pedicle: this accounts for the formation of the mesenteries, the uterine, vesical ligaments, &c.: above, where the organs are very numerous, where all have not only a pedicle which unites them to the abdominal wall, but also secondary pedicles, which connect them with the adjacent organs, the arrangement of the peritoneum becomes very complex. These causes, and particularly the existence of the secondary pedicles, determine the formation of the gastro-hepatic, splenic, &c., epiploa, and of the posterior cavity, which they circumscribe.

The arteries of the abdominal viscera come from the trunk of the aorta, or from that of the hypogastric artery; all the branches which are detached from the anterior and lateral faces of the former, except the diaphragmatic and spermatic, go to this part; the cœliac trunk, which belongs to the liver, spleen, pancreas, and stomach; the superior mesenteric, the convexity of which belongs to all the small intestine, and the concavity to the right side of the large intestine; the inferior mesenteric, which is distributed to the left side of the large intestine to its termination, the capsular and renal arteries. All the internal and anterior branches of the hypogastric artery, excepting the subpubic, are also distributed in the abdominal cavity, to wit, the termination of the middle hemorrhoidal and vesical arteries in the male; of the same, and of the uterine and vaginal arteries in the female. At first, all the veins follow the course of the arteries; but when once united in large trunks, they must be distinguished into two orders; some of them still attend the arteries, those of the urinary and genital organs; the others, those of the alimentary canal, unite in one trunk, the vena portæ, which ascends obliquely on the right, towards the transverse fissure of the liver, where it divides *arterially*. An enormous mass of lymphatic ganglions are also situated in the abdominal cavity, unconnected with its parietes: they are most numerous and remarkable in the mesentery, where they receive the chyliferous vessels from the small intestines; they occur in all the folds of the

peritoneum, where they receive the lymphatics from the adjacent organs: these ganglions are more numerous superiorly than inferiorly. The abdominal cellular tissue is abundant and very loose; the same is true of the fat: these two tissues exist particularly between the two layers of the mesentery, in the epiploa, &c.; in all these points, the vesicles of fat are arranged in ribands along the vessels.

2. *Relations.* The relations between the organs situated in the abdominal cavity are extremely simple, and must now be described, as also their position in relation to the wall which protects them: this knowledge can alone enable the physician to resolve this problem, viz. a point of the abdomen being wounded deeply, in a given direction, what organs are concerned? and reciprocally, an organ having been affected in a point of the abdominal cavity by a wounding instrument, in a given direction, to determine what part of the abdominal parietes must necessarily have been injured? But to attain this, the examination must be circumscribed; we may, however, suppose two horizontal planes, one of which passes under the edge of the last ribs, and the other above the crests of the ilia. We thus obtain three sections; the first is called the epigastric, the second the mesogastric, or umbilical, and the third the hypogastric. Two antero-posterior planes, drawn vertically from the centre of the crural arch towards the base of the chest, divide each of these regions into three which are smaller: the epigastric region, into the hypochondria on the sides, and the epigastrium in the centre; the mesogastric section, into the flanks, and the mesogastrium; the hypogastric, into the iliac regions, and the hypogastrium; the last is continuous with the cavity of the pelvis.

1. The parietes of the epigastric section are formed in the centre, by the superior angle of the great costo-iliac region, on the sides and posteriorly, directly by the region of the diaphragm, but the base of the chest and the costal region descend outward and backward on it. The organs contained by this part of the abdomen, are consequently protected immediately by the thorax, hence the name *thoraca*, applied to them by some anatomists. If we raise in one piece the whole anterior wall of the epigastric region, we see that this wall is free from adhesions, except on the right, where the suspensory ligament of the liver is attached; then in the cavity itself we find successively; the left lobe of the liver, situated before the gastro-hepatic epiploon, the end of the esophagus, the pyloric portion of the stomach, which touches downward, like the liver, the abdominal wall in a variable extent, by its anterior face when empty, by its great edge when filled. Below the epiploon mentioned, and behind the stomach, we find the posterior cavity of the epiploa, next the fold of the peritoneum, which forms this cavity posteriorly, the last two portions of the duodenum, the pancreas

imbedded in a mass of cellular tissue filled with lymphatic and nervous ganglions, situated superiorly adjacent to the cœliac trunk, surrounded by the solar plexus, and resting on the superior mesenteric vessels; below, finally, the centre of the posterior abdominal wall, and its large vessels. In the right hypochondrium, the liver adheres to the diaphragm, forward, upward, and backward, and fills this space so exactly, that it always presents itself when we raise its anterior, posterior, superior, or straight parietes. In the healthy state, the liver does not leave this point, but when it is morbidly enlarged, it comes to the anterior abdominal wall: the gall-bladder, when distended, always projects a little beyond the sharp edge of the liver; then also, its anterior face touches the costo-iliac region. Under the liver and its vesicle, we find the first portion of the duodenum, the upper extremity of the ascending colon, and the vascular pedicle which connects the liver to the stomach and duodenum, a pedicle formed by the hepatic artery anteriorly, the hepatic canal, the cystic canal, and the origin of the choledochus in the centre, by the vena portæ posteriorly, and also by some twigs of the tri-splanchnic nerve, and the end of the right pneumogastric nerve, all which organs are situated in the right edge of the gastro-epiploic epiploon, before the hiatus of Winslow. Directly behind the liver, we remark above, the vena cava inferior, which projects a little from the posterior wall of the abdomen, below, the upper extremity of the kidney, with its capsule, which adheres to it and to the liver. The left hypochondrium, on the other side, is filled by the splenic extremity of the stomach; above, however, we find a small prolongation of the left lobe of the liver, which advances on the stomach; this latter rests posteriorly on the spleen, to which it is attached by the gastro-splenic epiploon, formed of four layers, two anterior, which comprise between them the short vessels, and which, by a small prolongation of the posterior cavity of the epiploa, are separated from the two posterior layers, which intercept between them the splenic vessels and the tip of the pancreas. The upper extremity of the descending colon, the left kidney, and the renal capsule, proceed also to the spleen, behind this part of the stomach.

2. The centre of the ilio-costal region, and the lumbar region, form the circumference of the mesogastric section, which is continuous at its lower part with the hypogastric section, without any marked line of demarcation, but it is separated above from the epigastric section, by the root of the transverse meso-colon, which contains in its centre the third portion of the duodenum. If we raise the anterior and lateral parts of this circumference, we find it loose in every part, since we discover from before backward the gastro-colic epiploon, concealing the transverse colon, which is often flexed downward, so as to go even

into the mesogastrium. Below these parts, we observe the circumvolutions of the small intestine, attached by the mesentery to the posterior wall of the abdomen, the obliquity of which to the right and downward, gives to them this direction. In both flanks, the lumbar colon appears, below some folds of the small intestine, and is often attached to the posterior wall of the abdomen by a meso-colon, but generally, it does not project into the cavity of the peritoneum, but passes only on its anterior face. Finally, the kidney, and the fat which surrounds it, appear behind the lumbar colon.

3. The mesogastric section is continuous with the preceding, and with the cavity of the pelvis, corresponds to the lower portion of the costo-iliac wall, to the iliac and lumbar regions; its anterior wall, which is always free from adhesions, being raised, we see: the gastro-colic epiploon, the lower edge of which descends lower on the left than on the right, below, the small intestine, which exists singly in the centre, while, on the sides, we find, farther on the right, the cœcum, which rarely presents a meso-cœcum, but is generally covered only with the peritoneum on its anterior face, and finally, on the left, the sigmoid flexure of the colon, which presents the same arrangement, but more rarely.

4. The cavity of the pelvis, the circumference of which has been described separately, a cavity closed inferiorly by the perineum, a true abdominal wall, contains the bladder, anteriorly, which projects but slightly into the cavity of the peritoneum, with which it is covered almost alone posteriorly, from which arrangement it glides, in order to dilate, between the serous membrane of the abdomen, and the anterior wall of the pelvis and abdomen: the bladder, when slightly distended, leaves the cavity of the pelvis, and comes into the hypogastrium, behind the anterior wall of the abdomen; sometimes it has proceeded even to the umbilicus, to which its superior prolongation, the urachus, always extends. Behind the bladder, we find the two vasa deferentia, which converge, after crossing on the inside, the direction of the ureters, which are contiguous to the sides of the same organ: still farther back, is a more or less deep peritoneal depression, the vesico-rectal in the male, the vesico-vaginal and uterine in the female, into which the folds of intestine sometimes enter; we next find in the female; the uterus, the vagina, and the broad ligaments, which separate the pelvis into two halves, an anterior and a posterior; finally, nearer the sacrum, a peritoneal depression, which varies in length, and is termed the vagino-rectal, into which, also, the folds of the small intestine often enter; in the two sexes, the rectum comes the last; it rests against the sacrum, and is attached there by the meso-rectum

above, while below, it is covered by the peritoneum only anteriorly, where it enters into the perineum.

Development. The rudiments of the principal abdominal organs, especially those of the small intestine, can be observed before the abdominal cavity exists; the latter is then formed upon them, and the anterior part does not appear till at a late period. The mesogastric region is found first; next, the hypogastric and the pelvic; the epigastric appears last: the abdominal cavity is blended with that of the umbilical cord, in the early months: it is considerably large compared with the other splanchnic cavities, a fact which is connected with the great development of the parts it contains: its parietes are proportionally very thin. At birth, the gastro-colic epiploon does not exist; it is formed by two layers which arise separately, one from the great curve of the stomach, the other from the arch of the colon: at two years, the loose edge of these two layers unite, and the posterior cavity of the epiploon, which was previously open inferiorly, is closed in this point. At birth, there is no trace of fat in the abdomen, and the size and relations of certain organs differ from what has been stated: the liver fills the epigastrium entirely, leaving on the left side a small space for the upper extremity of the spleen and stomach: the stomach is so crowded by the liver in very young fetuses, that it descends perpendicularly into the left flank. The liver descends into the mesogastrium, and even into the hypogastrium, and is in relation with the anterior wall of the belly; the intestines are crowded towards the spine, and are no where covered anteriorly by the epiploon, which does not exist. At first, the cœcum is situated in the left flank; next, in the mesogastrium, on the right flank; and finally, at eight months, into the right iliac region, so that the large intestine is at first only descending, then transverse and descending, and finally ascending, transverse, and descending. The bladder, the rectum, and all the genital organs, are at first situated out of the pelvis, and advance into the hypogastrium, preserving the relations of adult age. In the earlier periods, also, the bladder is continuous with the urachus, which passes out through the umbilicus; the kidneys, which are large, are united on the median line by a prolongation of their substance; their form is uneven. Finally, the testicles occupy, successively, the lumbar region, below the kidneys; then the different points of the inner edge of the iliac fossa, in which they glide before the iliac vessels, at least unless prevented by some abnormal adhesions: at birth, the testicle is situated out of the abdominal cavity. Until puberty, the proportional development of the abdominal cavity, especially that of its upper portion, is considerable; but at this period, the proportions, which have served as the basis of our examination, are seen, its pelvic portion, hitherto the most rudimentary part

of the cavity, enlarges very much; then, also, the sexual differences in this region appear more strongly: in the young girl, the pelvic portion enlarges, especially the upper pelvis, which becomes the largest point. This latter arrangement of the abdominal cavity, and the diminution of its capacity, above and below the great pelvis, gives it internally the form of a basin: in the young man, on the contrary, the epigastric region is enlarged, and the internal cavity has the form of a hollow cone, the base being situated superiorly. At puberty, but little fat is as yet found around the abdominal organs; but at the age of thirty-five to forty, it is deposited in great quantities, especially in some individuals, and forms long masses along the blood-vessels. This increase of fat dilates the cavity considerably, in which also the intestines are pressed upon more forcibly for the same reason; if, in these cases, a leanness rapidly supervenes, the viscera are no longer sufficiently sustained. In very aged persons, the fat of the abdominal cavity is often very abundant, and exists there exclusively.

Varieties. Besides the sexual varieties already mentioned, the abdominal cavity is carried farther backward in the female than in the male, which depends on the greater curve of the lumbar region in the former.

Those individuals in whom the abdominal viscera are transposed, present in the right part of the abdomen the relations mentioned as belonging to its left part, and reciprocally. Sometimes we find a single kidney situated before the spine: several years since, we found in a cadaver the right kidney situated in the cavity of the pelvis. During pregnancy, the abdominal cavity of the female experiences remarkable changes in its form, capacity, direction, the relations of its organs, and its circulation. In the first month, it seems to contract, and its parietes to collapse; at a later period, we observe opposite changes. On account of the resistance of the circumference of the pelvis, in which the uterus is at first developed, when this has acquired a certain size, it extends upward, and goes into the supra-pelvic part of the abdominal cavity, which it dilates anteriorly, and thus removes from the axis of the abdomen its anterior obliquity. The dilated uterus is situated entirely anteriorly, behind the anterior wall of the abdomen; it presses, on the side of the vertebral column, the small intestine, and the epiploon: this latter, however, sometimes, but rarely, remains in front of it. The uterus, also, crowds the diaphragm upward, and raises it to the sixth dorsal vertebra: on the other hand, all the peritoneal folds of the uterus disappear, the peritoneum no longer descends in the cavity of the pelvis, the bladder and rectum are very much compressed, and fulfil their functions with difficulty; the uterus, also, is inclined to the side, and most commonly to the right side; its inclination de-

pends on the projection of the vertebral column; its right obliquity is produced, according to Chaussier, by the shortness of the supra-pubic cord on the right side. Notwithstanding this enlargement of the abdominal cavity, the viscera are pressed upon with unusual force, and consequently form hernias more easily, as the distended and thin parietes have lost much of their resistance. The normal irritation which is situated in the uterus at this period, solicits a greater quantity of blood into the whole inferior vascular system, and particularly into its own; all the vessels of this organ are dilated, its structure is modified, &c. &c.

Uses. In the cavity of the abdomen, the processes of chymification, the formation and the absorption of the chyle, the secretion of the urine, &c., take place, to which functions this cavity also contributes; in fact, the abdominal parietes press more or less forcibly upon the viscera, and indirectly upon their contents; this pressure upon each part of them, solicits them toward the axis of the cavity, and in such a manner, that they are always propelled towards the anterior part of the circumference of the pelvis, and particularly toward the right groin; this obliquity is in a direct ratio with the inclination of the axis of the upper part of the abdominal cavity. The viscera contained in the pelvis are protected from this effect of the parietes by the direction of the axis of that part of the cavity which receives them, which direction is such that this axis does not blend with that of the supra-pelvic part. This protection of the organs of the pelvis against the constant action of the abdominal parietes, is connected with their functions of serving for the receptacle of the urine, of the fetus, &c. Farther, in cases where these contain parts that are to be expelled, we naturally incline forward the upper part of the abdominal cavity, so as to unite the axes of its pelvic and supra-pelvic portions; the contractile action of the parietes is then more or less increased by these efforts, and extends toward the base of the pelvis, acts upon all the organs, and is transmitted directly to the contents, which soon pass in this direction. This is the reason why we lean forward, when the urine or the feces are expelled with difficulty. During labor, also, the position of the female should be regulated by these important ideas.

When the diaphragmatic wall of the abdominal cavity is depressed, the anterior and lateral parietes yield; when it rises, the last contract, so that the abdomen always preserves the same capacity. The action of the muscles is independent of these motions of the anterior and lateral parietes, they in fact yield and are restored by the elasticity alone. In efforts, especially in those of vomiting, the case is different; the diaphragmatic and anterior walls of the abdomen contract together,

the abdominal cavity is contracted, and the viscera are subjected to considerable pressure.

Pathological and operative deductions. We have already mentioned the openness of the abdomen externally, in consequence of the imperfect development of its parietes; this division may be confined to them, or it may extend to some of the deep organs. The anterior fissure of the pelvic part of the abdomen also causes the division of the bladder anteriorly; hence, extrophia of this organ, a deviation of formation already mentioned in another place. The different abdominal viscera are also subject to imperfections, which we shall not mention here, as they belong to descriptive anatomy; the most remarkable are those which consist in a more or less perfect interruption of the intestinal canal. Most authors think that these deviations of formation are produced by a partial obliteration and atrophy; in fact, in certain cases, we find between the two extremities or cul-de-sac of the intestine, a cellular filament, which may be considered as the remnant of the obliterated canal; but in some cases, we find no connexion, no relation of position between these two parts; hence, it follows, that it is difficult not to admit that the obliteration of the intestinal canal is not, in all these cases, the principle of this anomaly. Can this latter state confirm the opinion of those who think that the intestinal canal proceeds from the mouth and from the anus by two prolongations, which meet, and generally unite in the abdomen? Be this as it may, we have a fetus which presents in the small intestine an instance of each of the interruptions mentioned; one is perfect, and no marks of an ancient continuity between the corresponding ends remain; the other is imperfect, and a very thin cellular filament still marks the continuity. Wounds of the abdominal cavity, or penetrating wounds of the abdomen, are generally very severe; the most simple usually give rise to a slight peritonitis; these wounds may be complicated with bloody, serous, or purulent effusions, with lesions of the viscera, and even with emphysema. When a small quantity of blood is effused into the abdomen, it obeys the law of gravity, and goes toward the base of the anterior abdominal wall, and particularly toward the right inguinal region. Sabatier has remarked, that the contractile reaction of the abdominal parietes is one cause of this phenomenon; we might also add, that the direction of the axis of the supra-pelvic part of the abdomen is exactly that followed by the effused matters in going downward. When the organ, which by its injury supplied the effused material, is near the external wound, the blood, or other fluid matters, often escape through this wound, instead of falling into the cavity of the peritoneum. This phenomenon is very simple; in fact, the fluids, on leaving their passages or reservoirs, tend to go to that part where

there is the least resistance; but it is evident they will be subjected to no pressure on the outside of the abdomen, while on the inside they will have to support all that of the contractile parietes of this cavity. This, also, is the reason why we have seen wounds complicated with the opening of certain vessels and of other abdominal organs, although their respective fluids were not effused; the circumstances, however, are not always so fortunate, and effusions of bile, urine, and of food, into the abdomen, are not unfrequent, in wounds of the gall-bladder, bladder, and stomach. On account of the constant action of the abdominal parietes, their wounds cannot be kept in place without the employment of the quilled suture; wounds in the intestinal canal also require a special suture, although we cannot hope for a regular cicatrization, since the edges of these wounds are constantly separated and thrown outward by the action of the muscles. Farther, the suture to be employed is the interrupted suture modified by Beclard. If, on the contrary, the intestine is entirely divided, we must invaginate the lower end in the upper end, taking care first to draw this into itself. This mode, invented by Joubert, presents the great advantage of the contact of the serous membranes of both extremities of the divided intestinal canal, and a prompt union is obtained, after which there remains in the intestine only a floating fold, which may be compared to a large valvula connivens. These different intestinal sutures, however, cannot be admitted, except where the injured part has left the abdominal cavity; to look for it in the abdomen, would expose to irritation. Finally, in wounds of the abdominal cavity, emphysema may appear, as we have remarked; it is produced in the following manner: when the diaphragm reascends in the normal state, it is followed, as we have seen, by the anterior and lateral abdominal wall which rises; and thus the space which the first tends to form on the side of the abdomen, does not exist; but when the peritoneal cavity is opened, the air may enter into it during the elevation of the diaphragm, especially if this takes place rapidly; next, then, this elastic fluid is pressed by the depression of the diaphragm, and must necessarily tend to leave it altogether, or to enter into the cellular tissue, if the wound on the outside be narrow. We must however admit, that in most cases of wounds of the abdomen, where emphysema has been observed, the pulmonary and peritoneal cavities were injured, which injury was favored, as we have said, by the interlacing of the chest and abdomen. We do not speak of the special organs which may be wounded in different affections of the abdomen; the relations which have been mentioned state this sufficiently. The internal viscera may be injured without a wound of the peritoneum. Richerand has proved by experiment, that in falls from a lofty place, the liver is generally contused;

this is probable, from its softness and size: hence the solution of the problem, which had been looked for in vain by Bertrandi and Pouteau, viz. *to determine the cause of abscesses of the liver in wounds of the head.*

A greater or less portion of the mass of intestines may descend in hernia, and then the abdominal cavity contracts in a proportional degree; this accounts for the difficulty in reducing old and very large hernias. When the epiploon and the small intestine form a hernia together, the first is always situated anteriorly; this is also the position it normally occupies in the abdominal cavity; hence the precept in reducing these parts, to act first on the intestine, then on the epiploon; if any other course were pursued, we should run the risk of turning one of them around the other, and of producing an internal strangulation. Abscesses of the liver may open into the chest, if they are developed on its convex face; those on the opposite face always point in the stomach, the duodenum, or the arch of the colon, of which we can easily form an idea, if we remember the relations of the organs of the right hypochondrium; other abscesses of the liver sometimes raise the ilio-costal region, and open on the outside; if in these kinds of abscesses we think proper to make an artificial opening, we must use the caustic potash; if we use the lancet, we might proceed beyond the adhesions of the pouch, and open the peritoneum; the potash has not this inconvenience, it acts by forming an eschar, around which adhesions occur when it sloughs off. The same course must be pursued, to open the gall-bladder, when enormously distended by calculi; biliary cistotomy cannot be performed by a cutting instrument, except by a surgeon entirely destitute of anatomical and pathological knowledge; this is not true of the puncture, or of the incision of the neck of the urinary bladder, to evacuate urine, or extract the calculi contained in it; these operations are founded upon our remarks upon the anterior relations of the bladder with the anterior abdominal wall, relations which are established, independent of the peritoneum. This arrangement exists directly above the pubis, and these operations should be performed there; we do not speak of the layers of the costo-iliac region, which exist on the raphe, and which are interested; we have already mentioned them; behind the abdominal wall, we cut only a very loose celluloadipose tissue, and the anterior wall of the bladder; for puncturing it, the curved trocar of Cosme is the best instrument to use; it allows us to reach the bladder even very low behind the pubis, without touching its posterior wall. In the high operation of lithotomy, if the sound is carried through an opening previously made in the perineum, its tip easily rubs against the anterior wall of the bladder, which is difficult to be accomplished, if this sound is simply introduced into the urethra;

this single reason is sufficient to show all the importance of the opening in the perineum, made in the high operation of lithotomy, which has been doubted by some persons; another reason why this precaution should not be neglected is, it prevents the infiltration of urine, the discharge of which is facilitated by its sloping position. The infiltrations which may occur, are much more serious, as they extend very rapidly into the sub-peritoneal, pelvic, and perineal tissues, which are extremely loose, as we have seen. The abdominal organs, without constituting an external hernia, may be strangulated in different ways, in the abdominal cavity, by bridles, invaginations, or by the twisting of some parts around others. We have seen at La Charité, a very remarkable instance of this last kind of internal strangulation; most of the fold of the small intestine, after ascending on the right into the epigastric region, had come through the hiatus of Winslow, into the posterior cavity of the epiploa, from which it emerged through a narrow abnormal opening in the transverse meso-colon, which opening had pressed forcibly upon the intestine, and had caused sphacelus. In a case where a patient presents all the symptoms of internal strangulation, must we, guided by this alone, perform gastrotomy, open the abdominal cavity, and look for the strangulated part, to relieve the symptoms? This operation is rejected by sound practice, because symptoms analogous to those of strangulations, may be produced by other diseases; and also because, if we were certain a strangulation existed, we must determine its situation and nature, before operating, which is generally impossible. Gastrotomy, applied to the treatment of internal strangulations, would be proper only where, in a particular case, the symptoms continued, after the hernia had been reduced in a mass, and we have reason to believe the strangulation existed; but then its situation and nature are known. From the lateral deviation of the uterus during pregnancy, one of its edges becomes a little anterior, and as the very dilated trunks of the uterine arteries are situated in these points, it has been advised, to avoid hemorrhage, when cutting the uterus, in the Cesarean operation, not to operate on the median line. Taking into view the severity of wounds of the uterus, and the facility of reaching the vagina, above the superior strait of the pelvis, in the latter months of gestation, Baudelocque* has proposed in the Cesarean operation, to open the vulvo-uterine passage, after making in the costo-iliac region, near the fold of the right groin, an incision, oblique from the flank to the pubis; he advises to divide the peritoneum; perhaps it would be more advantageous, only to separate it

* This operation was proposed before Baudelocque, by Prof. Riegan, of Giessen, and Prof. Physic, of Philadelphia, and was also mentioned by Dubois, in his course.

from the iliac fossa, which is easy, as in the latter periods of pregnancy, the peritoneum of the cavity of the pelvis, as has been mentioned, ascends to the superior strait, being drawn upward by the enlarged uterus. M. Baudelocque, however, has not abandoned this process. The selection of the right portion of the abdomen for the operation, is founded on the observation of the right lateral deviation of the uterus. After attacks of peritonitis, the abdominal viscera adhere intimately, by which their motions are more or less impeded. In diaphragmatic peritonitis, a diaphragmatic pleurisy is often seen consecutively, and vice versa; this depends on the common source from which the vessels of the peritoneum and of the diaphragmatic pleura proceed. When serum is effused into the abdomen, which constitutes ascites, sometimes it occupies the whole cavity, and sometimes it is situated in a circumscribed point. We have observed dropsy of the single posterior cavity of the epiploa; this variety of encysted ascites must be attended with very great derangement in the functions of the stomach; in fact, this viscus is crowded forward, and is flattened against the anterior wall of the abdomen. There are also many other encysted dropsies of the abdomen, among which we distinguish principally that of the ovary, in which several pouches generally exist, each of which contains a fluid, distinct in respect to its physical and chemical properties. This disease, which is often attended with other organic affections of the ovary, is rarely situated on both sides at once; it may be recognised by its commencing near one of the iliac regions; but at a later period, the tumor fills the whole of the abdominal cavity, and can with difficulty be distinguished from ascites. In dropsy of the ovary, the puncture should be made on the side affected; in common ascites, the left side is generally selected, because the liver often impedes the operation on the other. When adhesions between the epiploon, or the intestines and the abdominal wall are suspected, we must divide this with a bistoury, and when the serum is evacuated, we must apply a bandage to the abdomen, to support the vessels of the cavity, and to prevent their engorgement with blood, and consequently to oppose inflammation, which would easily supervene without this precaution. A body bandage is also applied to the lying-in female for the same reason, and also to facilitate the contraction of the parietes of the abdominal cavity. The attacks of peritonitis, which often supervene under these circumstances, are produced by the stagnation of blood in the abdominal vessels; this stagnation is much more easy, as these vessels have less support after parturition, and were previously the seat of a very active circulation, which may be considered as continued abnormally; when the small intestine descends in hernias, it is seen most frequently on the right, on account of the direction toward

this side imparted to it by the mesentery; when, on the contrary, it is the epiploon, it occurs most frequently on the left, on account of the greater length of its lower edge on this side. The vascular connexion of certain abdominal viscera with the posterior and perineal parietes of the abdomen, explains the good effect produced by the application of leeches, in diseases of this part.

PART II.

OF THE LIMBS.

The limbs are appendages or articulated prolongations of the trunk: they exist in most animals, and in the vertebrated classes are never more than four; in the invertebral genera, they are much more numerous.

In man, the limbs have been distinguished into upper and lower; but this distinction is convenient for him alone; hence, anatomists have long proposed to separate them, and term them according to the part of the trunk from which they seem to emanate, the thoracic and the abdominal. The limbs might have been described when speaking of the thorax and abdomen; but we should then have neglected the analogies they present, and consequently should have been unable to have spoken of them generally, the only mode of simplifying description, and of avoiding tedious repetitions. Farther, whatever may be our ideas on this subject, we cannot but observe the numerous analogies, and also the marked differences, between the limbs. The first will be mentioned in the general description; the second will form our special remarks upon the same subject. The limbs are arranged symmetrically, so that those on one side are perfectly similar to those on the opposite side, except that those on the right side are larger than those on the left. The limbs have the form of truncated pyramids, the base of which rests on the trunk, and the point of which is loose, and divided into five distinct segments. They are remarkable in our species for their freedom; this contributes to render them elegant and moveable.

Their direction varies singularly ; to study them, we suppose them placed perpendicularly ; their length is nearly the same ; this depends on various circumstances, which will be mentioned hereafter. Each limb is formed of four great principal divisions, united by joints, which are generally enlarged, and form important regions.

Structure.—1. *Elements.* In the limbs we find ; a central skeleton, formed by long bones, united by articulations,* which are more moveable on the side of the trunk than on the opposite extremity ; some muscles forming two layers ; a superficial, with long and very contractile fibres ; the other deep, with short fibres, which have less contractile power, which is attached to the bones : all are surrounded with a very strong and almost inextensible aponeurosis, which sends toward the bones, in the muscular interstices, some fibrous septa, on which the muscles are inserted, which are thus surrounded with real sheaths ; the arteries, coming from a single trunk, situated at the upper part of the limb, and connected by some anastomoses to those of the trunk ; some superficial and deep veins go toward the heart, by a single branch, all of which are provided with internal valves, which are more numerous in the deep† than in the superficial veins ; some lymphatic vessels, which are also superficial and deep ; they terminate in the lymphatic ganglions, and are always placed at the articulations ; some nerves, which interlace in a plexus at the origin of the limb ; much cellular tissue, which must be divided into the sub-cutaneous and sub-aponeurotic ; the first is more compact, and retains nearly all

* This structure does not exist in all animals. Carlisle has demonstrated, that in the loris and the tardigradœ, the arteries of the limbs, on entering there, divide into numerous ramuscales, and again unite in one trunk. Is this singular peculiarity of structure intended to diminish the action of the muscles, by retarding the course of the blood in the limbs? Is this also the cause of the slow gait of these animals?

† This opinion is entirely opposite to that of authors generally, but it is founded on the results of a great number of comparative dissections and injections of the two venous layers of the limbs. A good idea of this may be gained by inspecting Plate seventh, where in Figure first the superficial veins have been figured as distended by the injection, as are also the deep-seated, Figure second. The nodosities, which mark on the outside the valves, are much more common in the latter. It is sufficient to mention this fact, without assigning a reason ; as, however, authors have attempted, theoretically, to demonstrate the necessity that the valves should predominate in the superficial veins of the limbs, it becomes at least curious to examine this. Numerous veins were necessary in the deep valves, because their parietes are feeble, and because being pressed upon by the muscles, in the interstices of which they are situated, their parietes must overcome, in the circulation, considerable friction ; and perhaps, also, because, being near the arteries, in which the blood circulates from above downward, a shock is necessarily impressed upon them in this direction. The case is the reverse with the superficial veins, and they have less need of these moveable valves, which facilitate the course of the venous blood, by breaking the columns which it forms, and consequently, by allowing a less weight to press on the lower part of the tube of the veins, and on their capillary system.

the cellular tissue; the second is more loose and lamellar, and contains but little of cellular tissue, which is always seen in certain places; finally, the skin, which is more or less hairy, and more dense on the back of the limb than on the opposite face.

2. *Relations.* These different elements are arranged in every part in the following order: the skin, a cellulo-fatty layer, which contains all the cutaneous vessels and nerves, particularly the veins and the large lymphatics; the inextensible enveloping aponeurosis; the superficial and the deep muscles, most of which are surrounded by a special sheath, and contain between them the large vascular and nervous trunks; finally, the bones, which occupy the deep parts.

Development. In the very young fetus, the limbs do not appear in the ovoid mass which represents it; but they soon vegetate, like small excrescences. They are the rudiments of the limbs; their form is at first very indistinct; but as they increase in length, it becomes very apparent. The first distinct part of the limbs is not, as we might suppose, their base or upper part, but the extremity, the hand or the foot; after this, we perceive the section next above it, and so on, successively; so that the part of the limb attached to the trunk, appears last: it is evident, that we allude here to the development of the external form of the limbs, for we should arrive at an opposite conclusion if we examine the development of the limbs in respect to structure. The five segments which terminate each limb in man, are not at first distinct; they are blended or united by a membrane, as is seen at the adult age in certain animals, particularly in web-footed birds.

Varieties. During the early periods of life, the limbs are remarkable for their rounded form, which depends on the sub-cutaneous fat, and for their enlargements at the articulations; in the adult, the muscular prominences are visible, as the secretion of fat is diminished; in the old man, the fat disappears in great part in the limbs; they remain thin, and the prominences of the bones are visible.

In the female, the infantile state continues, the sub-cutaneous fat enlarges the limbs, at the same time that it contributes to their grace, by concealing the prominences of the bones and muscles. When the development is not regular, the limbs may be deficient or entirely rudimentary, as has been mentioned when speaking of the development, which may be arrested at variable periods.

Uses. Nature has admirably formed the limbs for a double purpose, solidity and mobility, which, however, are generally in an inverse ratio with each other; sometimes one, sometimes the other, predominates. The greatest mobility is found at the union of the first two sections; the loose section, on the contrary, is remarkable for its solidity.

Pathological and operative deductions. A great number of general consequences, which are very useful, may be deduced from the preceding facts. In fact, did not the two muscular layers of the limbs lead Petite and Cheselden to propose cutting the muscles at two periods, in circular amputations, in order to obtain a stump representing a hollow cone? Is it not the inextensibility of the enveloping aponeurosis, which renders deep inflammations of the limb so serious, while the superficial are so slight? Do not these same anatomical facts lead us to make large incisions, in order to remove the strangulation passively exercised by this inextensible layer on the deep parts? Is it not because all the arteries of a limb come from a single trunk, that this is compressed in operations, that it is tied to arrest a hemorrhage from the part below it, or to check the progress of aneurism? And, finally, after this ligature is applied, does not gangrene sometimes supervene below the ligature, although much more frequently the collateral communications with the arteries of the trunk are sufficient to maintain the vitality of the parts? Is not a similar arrangement in the venous system of the limbs sufficient to show that the ligature, the compression or the obliteration of a vein of the limbs, by clots, may cause infiltration and abscesses? Finally, is it not on account of the too great natural mobility of certain points of the limbs, that luxations supervene there so frequently, and fractures more rarely; the bones, in fact, yielding before the causes of fracture, while, where the parts are more solid and less moveable, we observe the opposite phenomenon?

SECTION I.

OF THE THORACIC LIMBS.

These limbs are the articulated prolongations of the thoracic part of the trunk. They are the anterior limbs of quadrupeds, the wings of the cheiroptera and of birds, the pectoral fins of fishes.

In a well-formed male, the thoracic limb is so long, that, when extended on the sides of the trunk, it descends to the middle of the thigh. This limb is singularly elongated, by the arrangement of the hand, which, being articulated with one of its extremities by the fore-arm, adds its own length to that of the limb. In animals, the proportional extent of this limb is very much increased.

In order to study the thoracic limb, we consider it as hanging on the side of the trunk, the palm of the hand looking forward. In this position, we distinguish, an anterior palmar face, which is slightly concave in the centre; a posterior dorsal face, convex in the same point; two edges, one of which is radial, and is remarkable for three eminences arranged on the same line; the acromion process, the epicondyle and the styloid apophysis of the radius, which arrangement must be constantly kept in mind in reducing fractures; the other, the cubital, which also presents three eminences, the head of the humerus, the epitrochlea, and the styloid process of the ulna, which eminences are not arranged like the preceding; in fact, the central is more internal than the other two; the base of this limb rests on the upper side of the thorax; its summit is loose, and is represented by the extremity of the fingers.

Development. The thoracic limb appears earlier than the abdominal limb; its development is connected with that of the lower part of the neck, from which its nerves proceed; it is formed with the neck, in the variety of acephalia, termed by Beclard, atrachelo-cephalia; it is absent, on the contrary, although the thorax exists, in the other variety, termed abrachio-cephalia.

Uses. Every thing in the thoracic limb is calculated for mobility; the levers generally employed are those of the third class; these levers are not very solid, but extremely moveable, and find points of support in the loose articulations, the cavities of which are superficial; the powers which move these levers are inserted in them very obliquely; the section by which this limb rests on the trunk is itself very moveable, and its attachment to this part is not very firm. These circumstances favor the mobility, and hence dislocations of these limbs are more common than fractures.

The four divisions of the thoracic limb are, the shoulder, the arm, the fore-arm, and the hand, which we shall examine successively.

CHAPTER I.

OF THE SHOULDER.

The first part of the thoracic limb, the shoulder, is the base by which this limb rests on the trunk; its height and breadth are measured by that of the two regions which form it, and we shall consequently speak of it hereafter. The shoulder of man is moveable on the trunk, and it contributes singularly to the mobility of the whole limb; it may be raised, depressed, carried forward, backward, and may be rotated.

Notwithstanding the early development of the bones of the shoulder, this part of the thoracic limb is the last to appear in the fetus: this would seem contradictory to what is generally admitted in regard to its bones, if we did not premise, that in describing the evolutions of the limbs, we only referred to the appearance of their external form and their separation from the trunk.

The skeleton of the shoulder is formed by two bones, the scapula and the clavicle, which are firmly united, and represent a bent lever, on the two branches of which different organs rest, which thus form two regions, the clavicular and the scapular. Farther, this portion of the thoracic limb, by uniting with the arm and the trunk, contributes to form two other regions, the shoulder and the axilla.

1. CLAVICULAR REGION.

This region is very simple, and composed of the organs which are situated around the clavicle; it forms the upper and anterior portion of the shoulder. Its edges are well marked externally, they show the form of the clavicle; on the inside, also, this region projects forward, while externally it seems to retreat. Its length varies much, and is measured by that of the clavicle. In the female it is larger, on account of the disappearance of the curve of this bone; farther, its boundaries are easily perceived.

Structure.—1. *Elements.* The structure of this small region is not very complex. The clavicle forms its point of support, and its skeleton; the sterno-clavicular articulation has been examined in the sternal region; we will here add, that the clavicle is also united on the inside to the first rib, sometimes by diarthrosis, most frequently by the

costo-clavicular ligament, which is deficient in the former case. On the outside, this bone is connected firmly with the scapula in two points, first, by its extremity, to the acromion process, second, by its lower face, to the coracoid process, by the coraco-clavicular ligaments; this double scapulo-clavicular articulation is extremely important, in respect to certain fractures of the clavicle. The muscles attached to this point are the subclavius, the platysma, the insertions of the deltoides, the trapezius, and the sterno-mastoideus muscles; we find there a small aponeurosis, remarkable for its strength on the outside; this is the clavicular aponeurosis, the fascia clavicularis; it is attached on the anterior edge of the clavicle, and on the coracoid process, by a fasciculus, which we have long described as a third coraco-clavicular ligament; it is extended into the anterior wall of the hollow of the axilla, where it is situated on the axillary vessels and nerves, and it is attached to the upper edge of the pectoralis minor muscle. The vessels and nerves of this region are of but little importance; we, however, do not allude to the brachial vessels and nerves, which are situated below it; the supra-clavicular filaments of the cervical plexus, only, pass through the clavicular region. The sub-cutaneous cellular tissue is small in quantity, is dense, and not very fatty; under the platysma, it has an opposite arrangement. The skin presents nothing peculiar.

2. *Relations.* The clavicle forms in this region, to which it gives its name, a central layer, receiving in its outer third posteriorly, the insertion of the trapezius muscle, and anteriorly, that of the deltoides; the sterno-mastoideus muscle is inserted posteriorly, and the pectoralis major muscle anteriorly, in its inner third, while in the centre, its two edges are loose. The skin is separated from it by a slightly fatty and dense cellular tissue, by the platysma muscle, on which the supra-clavicular nervous filaments are situated on the inside, and finally, by a looser cellulo-fatty layer. The subclavius muscle is covered anteriorly by the clavicular aponeurosis, which forms for it a solid semi-sheath, separates it below from the upper opening of the hollow of the axilla, and from the vessels and nerves which pass through it; on the inside, the costo-clavicular ligament, alone, exists between it and the first rib; on the outside, it is united to the coracoid process, and to the coraco-acromial ligament, by the coraco-clavicular ligaments, and by a cellulo-fatty body.

Development. This part of the shoulder is short, and but slightly curved in the child; at the period of puberty, it acquires the development upon which our description is founded.

Uses. When the whole shoulder is moved, this region, by a singularly variable position, also causes the axillary and supra-clavicular regions to vary.

Pathological and operative deductions. Superficial wounds of this region are very slight; the small operations sometimes performed upon it, produce pains, which extend to the neck and the shoulder, by means of the supra-clavicular nervous filaments. Central fractures of the clavicle may be very serious, when they are produced directly by a force which acts from above downward; in fact, the fragments may be pushed towards the axillary vessels and nerves; fractures of the clavicle are produced, most generally, by a counterblow, and then they are not followed by these symptoms, but only with displacement; in fact, their external fragment is drawn downward by the weight of the whole limb, which cannot support the action of the trapezius muscle; on the other hand, the internal fragment is kept motionless, by the contraction of the sterno-mastoideus muscle, and particularly because it is acted upon by no force; from these different circumstances, there is a displacement in the thickness, and also an overlapping, produced by the traction of the shoulder toward the trunk, from the contraction of the pectoralis major and latissimus dorsi muscles. If the clavicle be fractured on the outside, between its acromial and coracoid articulations, the fragments cannot be displaced, because they are both united to parts of the scapula which have invariable relations, and also because the trapezius muscle is inserted backward and upward, the deltoides muscle forward and downward, in both of these parts. Caries and necrosis of the clavicle are common; its superficial position exposes it to syphylitic exostoses. The whole clavicular region may be depressed toward the axilla, or elevated toward the neck, by tumors developed in the neck or in the axilla.

2. SCAPULAR REGION.

This region is composed of all the organs which rest on the two faces of the scapula, and is larger and more complex than the preceding; it forms the posterior part of the shoulder, and rests on the thorax, which it enlarges upward and backward. Its form is that of a triangle, the base of which is superior; its height exceeds its breadth; in a state of rest it rises to the first true rib, and never extends below the sixth; its limits can be seen, or are easily felt.

The scapular region presents two faces, a posterior, which is cutaneous, and an anterior or axillary. The first is covered with hairs in adult males, it is convex, and shows, in lean individuals, the oblique prominence of the spine of the scapula; the second is concealed deeply in the hollow of the axilla, to the parietes of which it contributes; it is nearly plane, and cannot, for this reason, rest, except by one point,

its posterior edge, on the convex face of the costal region; this face, also, of the region, forms with the costal region a sinus, open anteriorly, which constitutes the hollow of the axilla, as we shall soon see.

Structure.—1. *Elements.* The skeleton of this portion of the shoulder is represented by the scapula, and presents, posteriorly, the supra- and infra-spinal fossæ, separated by the root of the acromion process, and anteriorly, the sub-scapular fossa; the adjacent part of the shoulder also belongs to it. The supra- and infra-spinatus, and the sub-scapularis muscles, are nearly the only intrinsic muscles. We find there only a portion of the trapezius, the deltoides, the latissimus dorsi, and of the teres minor and major muscles: the rhomboideus, the levator anguli scapulæ, the scapulo-hyoideus, and the serratus major anticus muscle, go only to the limits of the region. We do not mention here those muscles which leave the scapula, and only surround the shoulder. The scapular region is strengthened by three aponeuroses, which keep the sub-scapularis, the supra-spinatus, and the infra-spinatus muscles constantly in contact with the bone; those of the first two muscles are very simple, and are attached around the sub-scapular and supra-spinal fossæ: the last, also, is attached on the limits of the fossa to which it belongs, but it is also united to the trapezius and deltoides muscles, and extends under their two faces: it sends septa between the infra-spinatus and the two teres muscles, and then between these two latter; these septa serve for their insertion, and are attached to the crests of the scapula. These three aponeuroses are extended toward the shoulder, and are there expanded. The scapular arteries come from the subclavian and axillary; from the first come the posterior and superior scapular, and the common scapular and posterior circumflex from the second; they arise very low. These vessels anastomose extensively in the scapular region, and establish a very important collateral circulation between the subclavian and the end of the axillary artery; one anastomosis is situated near the lower angle of the scapula, it is formed by a branch of the common scapular artery, which follows the anterior edge of the region, and by the end of the posterior scapular artery, which extends along its spinal edge: another, the dorsal, is formed by the second branch of the common scapular artery, and by the end of the superior scapular. The veins attend the arteries, as do also the deep lymphatic vessels, which go with the superficial into the axillary and cervical ganglions; some of the latter turn on the posterior edge of the axilla, and others re-ascend on the trapezius; the cellular tissue is dense only under the skin, it contains very little fat, and we find but little of it deeply, except between the trapezius and the supra-spinatus muscles; the skin is remarkable sim-

ply for its firmness, its numerous follicles, and the hairs which cover it in very hairy men.

2. *Relations.* The relations of the scapular organs must be considered at the supra-spinal and infra-spinal fossæ. In the first space, which is very small, we find successively; the skin, a dense cellulo-fatty layer, the trapezius, a cellulo-adipose body, which is large, particularly on the outside, doubtless to shield in this point the posterior edges of the clavicle and of the acromion process, in which body we see a very considerable twig of the posterior scapular artery; more deeply, come the supra-spinal fascia, the supra-spinatus muscle, and between it and the bone, on the outside, the supra-scapular vessels and nerve, the last passing by itself into the coracoid foramen, on which the scapulo-hyoideus muscle is inserted; finally, below the bone, the sub-scapularis muscle, and its aponeurosis. At the infra-spinal fossa, we demonstrate successively by dissection; the skin, the cellulo-fatty layer already mentioned; in which layer we find only some cutaneous twigs of the common scapular artery, and the circumflex vessels and nerves; a third layer, formed first above by the deltoides, covered with a thin aponeurotic layer, which is continuous with the infra-spinal aponeurosis, and by the triangular tendon of the trapezius, which adheres to this same aponeurosis; second, below, by the latissimus dorsi; third, in the centre, by the infra-spinatus, the teres major and minor, which are covered with the infra-spinal aponeurosis. Although these last organs form here a superficial plane with the deltoides muscle, the trapezius and the latissimus dorsi constitute also a subjacent layer: finally, below them, and on the outside, we find the large anastomosis of the common and superior scapular arteries, and the skeleton, on the inside of which appear also, the sub-scapularis muscle, and its aponeurosis. The posterior scapular artery, the inferior branch of the common scapular, and the great anastomosis, which unites them near the inferior scapular angle, are situated on the limits of the region.

Varieties. In some individuals the posterior edge of the scapular region is elevated posteriorly, a very common variety, most generally produced by the transverse contraction and lateral roundness of the thorax, but which may also be caused by the shortness of the clavicle. This deviation of formation gives to the chest a peculiar appearance. In females, the transverse diameter of the chest is slight, but the great length of the clavicle, extending the scapular region outward, allows the posterior edge of the latter to rest as in the male. This region is extremely moveable; besides the general motions of the shoulder in which it participates, its muscles rotate it around an imaginary axis, which would pass through its centre; in this motion, the inferior angle is carried sometimes forward and sometimes backward.

Pathological and operative deductions. The scapular region is not very interesting in a pathological point of view, although very important, first, in respect to its uses as the wall of the axilla; second, on account of the anastomoses of its arteries, by which we are enabled to tie the axillary and subclavian arteries, without any interruption in the circulation, from the scaleni muscles to the base of the axilla; it is rarely fractured on account of its mobility, and of the muscular mass, a sort of elastic cushion, which protects its skeleton on the external surface. Its spine is the only superficial part. The chest is often examined by percussion, above this region; we must then expect to obtain generally a more obscure sound. The immediate relations of the supra-spinal fossa with the summit of the lung, enables us to perceive there pectoriloquy, in persons affected with phthisis. Tonnelé has shown us a scapula which presented an opening, through which a large pouch, filled with acephalocyst hydatids, extended at the same time upon the axillary and dorsal faces of the scapular region, raising on one side the sub-scapularis muscle, on the other, the infra-spinatus muscle.

3. SCAPULO-HUMERAL REGION.

The shoulder, by uniting with the arm, forms a blunt prominence, which has for the centre the scapulo-humeral articulation; it is the top of the shoulder, or the scapulo-humeral region.

On the inside, it contributes to form the axilla, it descends downward, below the pectoralis major and the latissimus dorsi muscles, which unite it to the trunk; above, its limits are less exactly defined, and are formed by the most external portions of the clavicular and scapular regions.

The shoulder is covered externally with hair in hairy men. Its form is rounded, when the arm is depressed. By pressing upon it, we can distinguish, above, the acromion process and the clavicle; on the inside deeply, the coracoid process; between these and the first two, a triangular depression, which corresponds to the coraco-acromial ligament and to the upper part of the articulation, which in this place only can be injured from above downward; finally, below, are two sub-cutaneous prominences, an anterior and a posterior, which unite the shoulder to the trunk and blend them; these are the prominences of the pectoralis major, and of the latissimus dorsi, and of the teres major muscles united.

Structure.—1. *Elements.* The scapulo-humeral articulation forms the centre of this region. We shall merely mention the length of its

fibrous capsule, which allows a greater separation between the surfaces which it keeps in place, its weakness at the lower part, while posteriorly, above and below, it is strengthened or formed entirely by the flat and very strong tendons of several muscles. The extremity of the humerus found in this region, is composed of the head of this bone, of the very short anatomical neck, which supports it and separates it from the tuberosities, and also of the surgical neck, which part comprises the space between the tuberosities and the place where the pectoralis major and latissimus dorsi muscles are inserted. This articulation is formed by the glenoid cavity and the neck of the scapula; it is protected by an osseo-fibrous arch, formed on the outside by the acromion process, on the inside by the coracoid process, in the centre, by the coraco-acromial ligament, which is partly covered by the acromial extremity of the clavicle, and is partially exposed to injury in a triangular space already mentioned. The muscles of the shoulder are numerous, but none belong exclusively to it; we find there the tendinous extremities of the supra-spinatus, infra-spinatus, teres minor, and sub-scapularis muscles, all of which are deep, and contribute directly to form the articulation; then, the upper extremity of the deltoides, of the biceps, of the coraco-brachialis, of the long portion of the triceps, of the pectoralis major, of the latissimus dorsi, of the teres major, and some fibres of the platysma; the long portion of the biceps passes through the articulation, the triceps is inserted directly below it, behind the lower part of its vertical diameter; the scapular aponeuroses are all extended, and terminate in this point, where the brachial aponeurosis commences by a thin layer.

The arteries come from the acromial, the circumflex, and the common scapular artery. The veins attend the arteries, except the cephalic, which proceeds on the anterior limits of the region. Superficial lymphatic vessels go partly to the axillary and partly to the cervical ganglions; the deep proceed to the first exclusively. The nerves of the shoulder are given off superficially by the supra-acromial and supra-clavicular filaments of the cervical plexus; the deep nerves come from the circumflex nerve.

Generally, the cellular tissue of the shoulder is not very abundant, and very loose; this is particularly remarkable under the muscles, where it frequently forms a mucous bursa, particularly between the deltoides muscle, the acromion process, and the articular capsule. Most of the fat is sub-cutaneous.

2. *Relations.* The relations of this region are very important, and must be examined superiorly, posteriorly, anteriorly, and also inferiorly.

In the first point, which corresponds to the deltoides muscle, we find, successively; the skin, an abundant cellulo-adipose layer, into

which some fibres of the platysma and the supra-acromial filaments of the superficial cervical plexus extend; a thin aponeurotic layer is continued between the fasciculi of the deltoides, and is connected anteriorly with the sub-cutaneous tissue of the thorax, posteriorly with the infra-spinal aponeurosis, inferiorly with the brachial aponeurosis; the deltoides muscle is separated anteriorly from the pectoralis major by a groove, where we see the cephalic vein and the vertical branch of the acromial artery. The deltoides muscle being turned back, we see, superiorly, the transverse branch of the acromial artery, passing on the coraco-acromial ligament and on the coraco-clavicular triangle, which has been rendered so important by Lisfranc's mode of disarticulating the arm, and farther back, the fibrous capsule, the tendons of the supra-spinatus, infra-spinatus, and teres minor muscles which strengthen it, the sheath of the long portion of the biceps, under which the small anterior circumflex artery passes from within outward; finally, still more inferiorly, the posterior circumflex vessels and nerves, which form a plexus around the surgical neck of the humerus; all these parts are separated from the deltoides by a very loose cellular tissue, which is lamellar, and often above by a mucous bursa, which glides under the acromial arch.

This region is continuous anteriorly with the anterior wall of the axilla, and we find there successively; the skin, a cellulo-fatty layer, some fibres of the platysma, and some supra-clavicular nerves of the cervical plexus, the terminating extremity of the pectoralis major muscle, which is separated, as has been said, from the deltoides, the short portion of the biceps, the coraco-brachialis muscle, and under them, above, the tendon of the sub-scapularis muscle, below, the anterior circumflex vessels.

Inferiorly, the shoulder is continuous with the posterior wall of the axilla, and consequently with the trunk; in this direction, it is formed from behind forward by the skin, a thin aponeurosis, the posterior edge of the deltoides, the long portion of the triceps, the teres major, and the latissimus dorsi muscles united, the first being situated posteriorly, the second anteriorly; finally, between these three muscles and the surgical neck of the humerus, the posterior circumflex vessels and nerves, and the weakest portion of the fibrous capsule.

Development. In youth, the osseous parts which protect the scapulo-humeral articulation are less prominent, and are cartilaginous.

Varieties. This region often changes its form, during the different movements in its articulation. In the male, the scapulo-humeral regions are thrown directly outward; they are carried a little posteriorly in the female. Boyer mentions a posterior slope of the glenoid cavity,

which facilitates a dislocation in this direction, which is otherwise impossible.

Pathological and operative deductions. When fractures supervene in this region, they affect particularly the acromion process or the clavicle, on account of the superficial position of these parts; a more violent effort is necessary to fracture the coracoid process, which is protected by the deltoides muscle and by its internal position; a great degree of violence is required to break the neck of the scapula; hence, these last fractures are much more serious. When they affect the humerus, they are situated sometimes in the anatomical and sometimes in the surgical neck. In the first case, the head of the humerus being deprived of its nutritive vessels, is, in fact, a foreign body in the centre of the articulation, and cannot contribute to the formation of callus; hence, this callus cannot be formed, unless we consider as such, a mass of bone which is sometimes annexed to the inferior fragment, and which surrounds the superior. The head of the humerus, subjected to the friction of the irregular summit of the lower fragment, is most commonly absorbed, and soon reduced to its cartilage of incrustation, which finally disappears; it is curious, that the pieces of bone which are detached, are removed but in a slight degree by absorption. In the second case, when the surgical neck is fractured, there is a remarkable displacement; the upper fragment is drawn upward and outward by the supra-spinatus, the infra-spinatus, and the teres minor muscles; the inferior is carried, first, inward, by the pectoralis major and the latissimus dorsi muscles, and is then drawn upward, by the contraction of the deltoides, of the biceps, &c. This latter fracture unites readily.

Dislocations of the shoulder cannot take place upward, on account of the arch which protects it; they are unfrequent backward and inward, on account of the resistance of the tendons which form the fibrous capsule, and especially because the motions of the articulation forward and backward are confined, particularly the former. Dislocation inward has been seen, and then the head of the humerus was situated under the tendon of the sub-scapularis muscle; dislocation backward, according to Boyer, is supposable only when the above mentioned deviation in the formation of the glenoid cavity exists; dislocations downward, however, are undoubtedly the most easy; the feebleness of the capsule in this point, and especially the quick and instinctive contraction of the pectoralis major and latissimus dorsi muscles, in falling on the ground, when the limb has been extended to support the body, are the causes of this frequency. The two muscles mentioned, produce this displacement by a curious mechanism: being attached to the humerus at the base of the shoulder,

they are destined, the opposite part of their action being neutralized, to bring towards the trunk the inferior end of the corresponding extremity, by making it swing on the shoulder, which they then draw downward: we can then conceive, that in a fall, whenever the lower extremity of the humerus or of the limb shall be fixed on the ground, the pectoralis major, latissimus dorsi, and teres major muscles, can no longer cause it to vibrate towards the trunk as before, but, on the contrary, they will produce this effect on the upper part, the ground instead of the shoulder having become the centre of rotation; hence, also, a part of the combined action of these two muscles, being normally to depress the shoulder, the continuance of this action must cause the head of the humerus to come from the lower part of the articulation. This head descends, first, on the axillary edge of the scapula, and presses more or less on the circumflex nerve, which is situated in this point; hence, a numbness of the shoulder, which is changed into paralysis, if the pressure continues for a long time. The known distribution of the compressed nerve, explains how that the deltoid muscle, losing its action, the power of raising the arm is lost. The rounded head of the humerus cannot long remain on the sharp edge of the scapula; hence, also, it glides on it, and goes upward, being drawn up in this direction by the contraction of the deltoides, of the biceps, &c. The relation of the long portion of the triceps with the vertical diameter of the articulation, explains why the displaced head of the humerus, being always situated in front of this muscle, cannot consecutively go backward, while there is no obstacle to prevent it from gliding into the hollow of the axilla, which is seen daily: in all dislocations, the alteration in the form of the shoulder is evident; it loses its roundness, the deltoides is depressed below the acromion process, and this eminence is prominent.

In scapulo-humeral hydarthrosis, the tumor appears forward and upward, and also downward and inward, in the hollow of the axilla; these, in fact, are the points around the shoulder where the fibrous articular capsule is the feeblest or the least supported: in the first point, the tumor appears in the space between the deltoides and pectoralis major muscles.

The superficial position of the articulation upward and outward, and also the few important parts which can be injured in this point, explain why surgeons have selected it to make the incisions necessary for removing the head of the humerus, an operation performed by Withe, Vigarous, Moreau, Roux, &c. In this point, whatever mode of operating may be selected, we can interest only the skin, the subcutaneous cellulo-fatty tissue, some supra-acromial nerves of the cervical plexus, the supra-deltoid aponeurosis, the deltoides muscle, and

the circumflex vessels and nerves. These also are the parts, of which, when the arm is amputated at the articulation, according to Lafaye's method, the superior flap is formed, while the inferior is composed of the inferior and internal layers of the shoulder, and also of the axillary organs. This latter flap consequently is that which demands the most care: it must be seized immediately by an aid, who is thus enabled to compress the principal artery of the limb. When, on the contrary, the wound has a perpendicular direction, making, as Desault advises, a posterior and an anterior flap, the first is composed of the skin, of the sub-cutaneous cellular tissue, of the sub-spinal aponeurosis, which is extended on the deltoides muscle, of this muscle, of the infra-spinatus and teres minor, of the triceps brachii, and of the latissimus dorsi and teres major muscles; finally, the posterior circumflex artery, and the circumflex or deltoid nervous twig, are divided behind the shoulder. The anterior flap, on the contrary, contains, the skin, the sub-cutaneous cellular tissue; the deltoides, pectoralis major, biceps, coraco-brachialis, and sub-scapularis muscles; the anterior circumflex artery, and the parts which we shall see in the axilla. But, finally, if we prefer the expeditious mode of Lisfranc and Champesme, we plunge the knife into the coraco-clavicular triangular space, pass through the fibrous capsule, which is strengthened by the supra-spinatus, infra-spinatus, and teres minor muscles, we divide the long tendon of the biceps in the articulation, and then by withdrawing the instrument, we form a flap, which contains all the deltoides muscle, with the skin and fibro-cellular tissue which covers it, and also the latissimus dorsi and teres major muscles, if we incline the point of the knife downward. The acromial and posterior circumflex arteries, and the deltoid nerve, are always divided in this flap: the second flap is composed of the inner part of the fibrous capsule formed by the tendon of the sub-scapularis muscle, of the pectoralis major muscle above, of the triceps below, of the axillary vessels and nerves, and of the skin.

4. AXILLARY REGION.

The axilla or axillary region, is the angle formed by the union of the trunk with the thoracic limb, and particularly by the contact of the shoulder and of the scapulo-humeral region with the upper extremity.

Some authors apply this term only to the depression of the skin, bounded by the edge of the pectoralis major and latissimus dorsi muscles; but we use it in a broader sense. The limits of the axilla are well marked: it is formed by the approximation of regions, which

also have distinct boundaries. The sinus which it represents, when the parts which fill it are removed, has the form of a triangular pyramid, one of whose faces would be curved, the internal, which face can be distinguished even in the simple depression presented by the skin. The base of the axillary pyramid is situated downward and outward, its summit upward and inward. This obliquity is caused particularly by that of its costal wall.

The form and origin of the axilla, as we have said, depend partly on the flattening of the scapular region; partly on the convexity of the costal region, from which circumstances these two bounding regions do not correspond exactly, except in a point, situated at the posterior edge of the second. This angle of separation is changed into a complete cavity by the pectoral muscles anteriorly, and by the skin inferiorly.

In order to study the axillary space to advantage, we shall consider first its parietes, and then the parts it contains.

1. *Parietes of the axilla.* Our statement that the axilla has a triangular form, naturally leads us to distinguish in it three parietes, a base, and a summit. The internal wall is formed by the costal region of the thorax, and directly by the serratus major muscle, on which glide some vessels and nerves, which we shall mention hereafter. The anterior wall is formed directly by the pectorales muscles, which separate at the angle of the costal region: on examining it more in detail, we find it formed by the following layers from the skin towards the axilla; first, the skin: second, a cellulo-fatty layer, in the centre of which some fibres of the platysma and the supra-clavicular filaments of the superficial cervical plexus are situated: third, the pectoralis major muscle, separated above from the deltoides by a triangular space, which is bounded also by the clavicle; the extent of this space varies, and in it the cephalic vein and the acromial artery proceed in opposite directions: fourth, below this plane, the anterior thoracic vessels and nerves, curved on the upper edge of the pectoralis minor muscle: fifth, this latter muscle, and the fascia clavicularis, which continues it towards the clavicle. The posterior wall is formed almost entirely by the scapular region, by the inner part of the shoulder, and directly by the sub-scapularis muscle; it is extended anteriorly, by the latissimus dorsi and teres major muscles, at which it comprises; the skin, a cellulo-fatty layer, which is dense and continuous with the infra-spinal aponeurosis: more deeply, the latissimus dorsi and teres major muscles, turned alternately so as to be deep and superficial;* the edge of

* Inferiorly, the latissimus dorsi is the most superficial, from behind forward; superiorly, the teres major muscle.

this plane, which is seen under the skin, is formed in almost every point by the latissimus dorsi, and by the teres major, only near the arm: finally, nearer the axilla, we find in this posterior wall, the common scapular artery, one branch of which goes backward, below the long portion of the triceps, which separates it from the circumflex vessels and nerves, and from the shoulder, while the other descends before the scapular region as we have stated. Of the angles formed by the approximation of these axillary parietes, two are internal, an anterior and a posterior, the third is external. The first two are very acute: the internal and anterior corresponds to the place where the pectoral muscles are detached from the thorax: the internal and posterior is formed by the separation of the serratus major and sub-scapularis muscles: the third, the external, is blunter than the others, and results specially from the union of the shoulder with the pectoral muscles. The base of the axillary pyramid, after the dissection of the axilla, appears in the form of a triangular opening, bounded by the pectoralis major anteriorly, the latissimus dorsi posteriorly, the costal wall on the inside; in it a portion of a very follicular skin is depressed, which presents long hairs analogous to those in the pubis. Under the skin, in the area of this triangle, which forms the base of the axilla, we find, a cellulo-fatty layer and some lymphatic ganglions, which may be termed superficial: then an aponeurotic layer, which goes from the latissimus dorsi to the pectoralis major muscle. The summit of the axilla is truncated, and dissection shows there a triangular opening, the anterior wall of which is formed by the clavicular region, the posterior by the upper edge of the scapular region, and the internal and inferior by the first rib: this opening establishes a communication between the axilla and the supra-clavicular region.

2. *Axillary cavity.*—1. *Elements.* The parts contained in the axilla, are principally the nervous and vascular trunks, which go to the upper extremity. We find there the axillary artery, which sends into the anterior wall of this space its acromial and anterior thoracic twigs; into the posterior, its common scapular and circumflex branches; into the internal, the long mammary artery. The axillary vein accompanies the axillary artery in every part, and receives branches analogous to those given off by the artery; it opens superiorly into the cephalic vein. The axilla is particularly remarkable in respect to its numerous lymphatic ganglions, which receive the lymphatic vessels of the corresponding limb, those of the back, mamma, costal region, and of the upper half of the anterior abdominal or costo-iliac region. The axillary nerves interlace in a compact plexus, which sends its branches particularly towards the arm, but gives some to the parietes of the axilla also; thus the anterior thoracic nerves come from it anteriorly,

posteriorly the proper sub-scapular twigs, and the circumflex or deltoid nerve, on the inside, the posterior thoracic nerve, the external respiratory nerve of Bell. From this internal wall also emerge some nerves, which pass through the axilla and go downward; they are the external twigs of the first three dorsal nerves; finally, the axilla contains also some sub-clavicular filaments of the superficial cervical plexus. All these parts are united by a very loose lamellar cellular tissue, and by some adipose bodies. The cellular tissue of the axilla communicates very easily with that of the neck, and directly with that of the mediastinum: it is continuous with the tissue under the pleura, by the openings through which pass the brachial branches of the intercostal nerves.

2. *Relations.* The principal axillary vessels and nerves are united in a fasciculus, in which the vein is always situated internally and anteriorly, while the artery is placed at first above, and is found between this vein and the nerves which occupy a more external and posterior point, and in the centre of the axilla, it is interlaced by the axillary nerves, particularly by the double origin of the median nerve, which surrounds it like a ring; farther, this is the place where the axillary plexus terminates, the branches of which continue to surround the artery, but less directly. This nervous and vascular fasciculus passes through the axilla diagonally, or obliquely from above downward, and from within outward, more and more remote from the costal wall; this direction is such, that at the upper opening of the axilla it is situated in the anterior and internal angle, and rests on the first two ribs; while below, it occupies the external angle, situated on the inner part of the shoulder. On the costal wall of the axilla, we find anteriorly, the long mammary artery, farther backward, the posterior thoracic nerve, while the brachial branches of the dorsal nerves leave it and go outward toward the arm. A branch of the common scapular artery, a long sub-scapular nerve, a fasciculus of lymphatic vessels and some arteries, descend perpendicularly on the anterior part of the posterior wall. The lymphatic ganglions occupy the course of the vessels, and are very numerous in the internal and anterior angle, and under the pectoral muscles.

Development. As soon as the shoulder is distinct, the axilla is so likewise. At the period of puberty, it increases remarkably, and at the same time some hairs grow on the skin, which is depressed in this point; at the same period, its follicles begin to secrete a musky odor, which becomes very strong in animals at the period of rutting.

Varieties. The axilla in the female is more superficial than in the male; but in return, its transverse diameter is greater, which depends on the length of the clavicle, which throws out the shoulder from the trunk. In some males the axilla presents the characters of the female,

from the same cause; it is remarkably narrow in other individuals, where the chest is rounded; a deviation of formation, in which the scapular region being raised posteriorly, rests anteriorly on the costal wall.

Uses. The uses of the axilla are evident; it facilitates the motions of the upper extremity, separating it from the trunk superiorly; in this respect we can conceive the importance of its depth, and of the lamellar cellular tissue which fills it. We must not, however, think, that the freedom of the motions of the limb is proportioned to the size of the axilla; this idea is refuted by what occurs in the female; there are, in this respect, some extremes, between which we find the formation most favorable to the easy play of the limb; this formation is that of the male in the normal state. In adduction of the arm, the lower part of the axilla is contracted; it is enlarged, in abduction; in motions of the shoulder forward or backward, the axilla experiences great changes; it becomes very large in the first, but diminishes very much in the second. The upper opening varies only in its dimensions by the motions of elevation or depression of the shoulder; it is enlarged in the first, and very much contracted in the second.

Pathological and operative deductions. Wounds of the axilla, even if not very deep, are extremely serious, on account of the important parts situated in this space. These wounds, however, are particularly dangerous upward and inward near the thorax, and downward and outward near the arm, because the vessels and nerves pass in this oblique direction. This fact should not be forgotten by the surgeon, in operating upon this part, in extirpating tumors, opening abscesses, &c.; below, along the pectoral muscles and near the thorax, we may be certain of being far from the principal vessels. The long thoracic artery, which is situated at this place, can alone be interested; but wounds of this, even, are by no means serious. If a wounding instrument penetrates into the axilla from before backward, it might wound the anterior thoracic artery: if it should come there from behind forward, grazing the anterior edge of the scapula, it might open, in the posterior wall and in the lower part, the common scapular artery, or one of its branches; and very high near the top of the shoulder, the circumflex vessels near their origin; but in this last case, the axillary artery might be injured. Emphysema has been observed in wounds of the axilla; this can be accounted for, by the alternate motions of dilatation and contraction, in the abduction and adduction of the arm.

The relation of the clavicular region with the upper opening of the axilla, explains the severity of fractures of the clavicle with depression, the fragments of which may lacerate the axillary vessels and nerves on the first rib. In primitive or consecutive dislocations of the hume-

rus inward, the head of this bone is covered with the sub-scapularis muscle, raises and compresses the fasciculus of the vessels and nerves; hence a numbness of the corresponding limb. The axillary artery may be compressed in two parts of the space where it is situated; first, on the second rib, on which it rests above; second, on the inner part of the top of the shoulder, below; in the latter point, the artery may be easily compressed with a pelote, as Garangeot advises; in the first, on the contrary, compression, although possible, is very inefficacious, for two reasons, even when made with the tourniquet of Dalh; first, because it cannot be made, except through the pectoralis major muscle, and the small subclavian fascia; and secondly, because the artery, being pressed from before backward, may easily escape from the action of the compressing power, by slipping toward the posterior angle of the axilla. Ganglionnary tumors of the axilla may result sympathetically from a disease of the corresponding limb, of the back, of the mammæ, of the superficial part of the thorax, and of the supra-umbilical portion of the abdominal parietes; anatomy demonstrates this, by the arrangement of the lymphatic vessels. Axillary abscesses are common; sometimes they are idiopathic, and sometimes result from purulent abscesses in the supra-clavicular region. There is no danger that abscesses, developed superficially on the pectoralis major, can come into the axilla, through the triangular space circumscribed by the pectoralis, the deltoides muscle, and the clavicle, because the fascia clavicularis forms in this direction an obstacle to its opening externally, which is not presented by the skin. All the axillary abscesses come below, and raise the skin, which they finally perforate, if left to themselves;* they often destroy the cellular tissue of the axilla, separate its parietes, and form fistulæ, which are very obstinate, on account of the constant motion of the parietes of this cavity, particularly on account of the constant separation of the muscles which circumscribe it, which separation keeps the opposite faces of the fistulous opening from being in contact. The axillary artery and vein are directly contiguous above, but are only united by a loose cellular tissue, which, perhaps, explains the rarity of well marked cases of varicose aneurisms at this point, while instances of false consecutive aneurisms are common. Of whatever nature the axillary aneurism may be, if large, it raises the clavicular region, and contracts in a measure the supra-clavicular space, where, in these cases, the artery must be tied; the inferior aneurisms of the axilla, and those of the upper part of the arm, alone, require the axillary artery to be tied in the axillary region; this ligature can be applied only

* It is difficult to imagine an axillary abscess opening spontaneously into the chest, unless the costal region is altered primitively by the abscess.

through the anterior wall of the axilla, and we always divide successively, the skin, the sub-cutaneous cellular tissue, the pectoralis major muscle, under which we must avoid the anterior thoracic vessels and nerves, while we cut the sub-clavicular fascia, between the clavicle and the pectoralis minor muscle ; we then come on the artery, situated between the vein, which is anterior and internal, the brachial plexus, which is external and posterior. In some methods, as that of Peletan and Hodgson, we divide perpendicularly the fibres of the pectoralis major muscle ; in other cases, we only separate its fasciculi.

CHAPTER II.

SECOND PART OF THE THORACIC LIMB.

This section of the thoracic limb is united upward to the shoulder, by the scapulo-humeral region, which we have studied, downward to the fore-arm, by the region of the elbow, from which it is distinguished by a line drawn circularly two fingers' breadth above the epitrochlea ; it includes the brachial region, and that of the elbow.

1. BRACHIAL REGION.

The arm, throwing out of view its varieties, is cylindrical, and slightly compressed transversely. It varies in length and size.

The arm presents four faces, a posterior and an anterior, both of which are convex ; the latter, however, more so than the former, presenting in the centre the prominence of the biceps : the third, the internal, presents a groove, in every part of which we perceive the pulsations of the humeral artery, which may be easily compressed there in the centre : finally, the latter face is external, and is remarkable in the centre, by a small depression, situated at the insertion of the deltoides muscle : this is the place selected for the application of the cautery.

Structure.—1. *Elements.* The arm is formed of a bone, of muscles enveloped by an aponeurosis, of vessels of every kind, of nerves, of cellular and adipose tissues, all which parts are covered and protected by the skin. The bone which forms the skeleton of this region is the

humerus, which, however, presents there only its central part, which is thin and compact, and which consequently is more fragile than the extremities. The muscles are superficial and deep, are formed, some of very long superficial fibres, and others of deep fibres, which are short, and are attached to the bones: a great part of the triceps, the biceps, the brachialis internus, the coraco-brachialis, exist there, while the deltoides presents there only its lower extremity: the pectoralis major and the latissimus dorsi belong, as we have seen, to the top of the shoulder. All are enveloped by the brachial aponeurosis, the arrangement of which is very simple. After forming a general sheath, it sends a very strong septum from its internal face, towards each lateral edge of the humerus; on the other side, it is attached to the tendon of the deltoides, and sends on it a very thin layer. Hence, are formed three special sheaths; an external, a posterior, and an anterior. The artery of this region is termed the brachial; it is the continuation of the principal trunk of the thoracic limb; it gives off to the different elements around it numerous branches, three of which are extremely important to the collateral circulation; they are the large and small muscular, or external and internal collateral, and the artery of the ulnar nerve. All anastomose with the recurrent arteries of the elbow. The veins are superficial or deep-seated; the latter follow the course of the arteries, the first are very distinct from them; two of the latter are important, the common centre of the superficial veins of the hand and fore-arm, the cephalic and the basilic veins: the cephalic is external below, and anterior above; the basilic is sub-cutaneous only in the lower third of the region; above, it is sub-aponeurotic, but always remains on the inside. The brachial lymphatic vessels go, some superficially, others deeply, into the axillary ganglions: most of them pass through this region, coming from a lower part of the limb Most of the brachial nerves are given off by five considerable trunks, all of which go towards the fore-arm and the hand: some filaments come also from the first intercostal nerves, and from the cervical plexus. All these nerves can be distinguished into muscular and cutaneous: the first come from the radial, ulnar, median, and musculo-cutaneous nerves: the second belong to the supra-acromial filaments of the cervical plexus outward and upward, while below they come from the cutaneous branch given off by the radial nerve, on emerging from the radial groove of the humerus; on the inside, they are the ramifications of the intercostal nerves, and of a cutaneous nerve, which is always given off by the ulnar nerve very high in the axilla. Finally, we must not omit the internal cutaneous nerve, which is also situated on the inside, half of it deeply, half superficially, but which only passes through the region, and distributes its first filaments around the elbow.

The adipose tissue of the arm is abundant, particularly below the skin: the skin is fine anteriorly and internally; it is thicker posteriorly, and has but little hair.

2. *Relations.* The arm is composed of a certain number of superimposed layers, formed by the preceding organs, and common to every part of it, or confined to circumscribed points. In proceeding from the skin towards the humerus, we find in every part a fine skin, slightly downy on the outside, and attached but feebly, except at the deltoides muscle; a cellulo-fatty layer, which is very loose except on the point above mentioned, where also there is less of fat, two things which contribute to form the depression below the deltoid muscle. A great number of superficial lymphatics, veins, and nerves, pass through this second layer, among which we may mention particularly; on the inside, the brachial filaments of the intercostal nerves, which incline backward; the cutaneous filament of the ulnar nerve, which descends perpendicularly towards the epitrochlea; the sub-cutaneous portion of the basilic vein and of the internal cutaneous nerve, which is already divided into two branches, and is directed downward and forward, on the outside the cephalic vein to the deltoid muscle, where it begins to be deep-seated, and finally the cutaneous filaments of the radial nerve, which emerge from the radial groove. A third layer, common to all the circumference of the arm, is formed by the brachial aponeurosis. More deeply, the parts of the arm no longer form layers, distributed uniformly in the periphery of the region; we must consequently examine their relations in the points which are circumscribed: at whatever part we perforate the brachial aponeurosis, we always come into one of the three sheaths mentioned above. Most of the first, which is external and superior, has already been examined in the region of the shoulder; at the arm, it contains only the lower angle of the deltoides muscle. The second, the posterior, goes principally to the triceps muscle, below which, on the humerus, the radial nerve and the deep muscular artery glide obliquely: from the external part of this sheath, the preceding nerve and the anterior branch of the artery which attends it, emerge, to pass into the anterior sheath, and is placed between the brachialis internus and the supinator longus muscles, while the posterior branch of this same artery descends perpendicularly toward the epicondyle, always remaining in the posterior sheath, like the trunk from whence it comes; near the inner edge of the sheath of the triceps, we find inferiorly the ulnar nerve and its attendant vein; both are directed obliquely towards the epitrochlea. The third sheath is anterior, and belongs in common to the biceps muscle, which is situated superficially, the coraco-brachialis and the brachialis internus muscles, situated inferiorly: we find the external cutaneous nerve

between them, which passes at the upper part through the coraco-brachialis muscle. This sheath contains, at its external and inferior part, as has been said, the trunk of the radial nerve and an arterial branch; at its inner part, on the contrary, it encloses in its whole extent the humeral artery and its two attendant veins, and also the median nerve, the relations of which with these vessels are extremely important: this nerve is external above, anterior in the centre, and internal below. Superiorly, we find this nervous and vascular fasciculus joined by the ulnar nerve, which soon leaves the inner part of the brachial artery, and penetrates into the posterior sheath, where it has already been mentioned; finally, the internal cutaneous nerve, the cutaneous filament of the ulnar nerve, and the basilic vein, which is situated deeply for a little space, and soon passes obliquely through the aponeurosis, and goes to the skin.

Development. In the formation of the upper extremity, the arm is distinguished the third. In fact, it appears after the hand and fore-arm, and before the shoulder.

Varieties. In the male, the external prominences of the deltoides, the anterior of the biceps, and the posterior of the triceps, are much more distinct than in the female. These prominences, added to the small quantity of sub-cutaneous fat, render the antero-posterior diameter of the arm much larger in the male than the transverse. In the female, the anterior and posterior muscles are thin, the sub-cutaneous fat abounds on the sides, which gives the arm a nearly rounded form; in her, also, *en bon point* effaces the relief of the basilic and cephalic veins, and the depression of the deltoides muscle, so visible in the male. We often find in the region of the arm two principal arterial trunks, in consequence of the premature division of the brachial artery. Meckel observes, and very justly, that one of the supernumerary branches in these cases, is sometimes and most frequently, the radial, and sometimes the inter-osseous artery; in this case, the brachial artery exists in its normal position, and has its common relations; the abnormal branch, on the contrary, exists more superficially on the inside of the first, sometimes even, as Meckel states, under the skin of the arm; this position, however, is very rare, for we have seen twenty-three cases of the premature division of the brachial artery, and have never seen one instance of it. We have once seen the artery divide above, and unite below. Meckel mentions instances of this arrangement. These varieties are important in operations on the arm, especially in applying ligatures to the brachial artery.

Pathological and operative deductions. The arm is sometimes entirely deficient, the last two sections of the limb existing; sometimes it is rudimentary. The brachial artery must be compressed at the

inner and central part of the arm; there, in fact, this vessel is situated superficially, and it is separated from the humerus only by the expanded tendon of the coraco-brachialis muscle, and consequently, the bone furnishes a point of support, sufficient for the compression of this vessel. Wounds of the inner part of the arm are more dangerous than those of the other parts, since there, only, the large nervous and vascular trunks are situated; nevertheless, a posterior and central wound, made by an instrument which penetrates to the bone, besides being attended with a profuse hemorrhage from the external collateral artery, might also, as we have seen at the Hospice Bicêtre, be followed with a paralysis of the extensor muscles of the hand and fingers; in fact, the radial nerve had been divided. Fractures of that part of the humerus which belongs to this region, are always accompanied with a change in the form or the length of the arm. If the fracture occur above the insertion of the deltoides muscle, this muscle draws upward the lower fragment to which it is attached, and the upper fragment is drawn inward by the pectoralis major, and latissimus dorsi; there is at first a displacement, and then a shortening. If, on the contrary, the fracture occurs below the deltoides muscle, the upper fragment may be kept motionless between the opposite powers of the deltoides, latissimus dorsi, and pectoralis major muscles: but most frequently it is thrown outward, by the more powerful action of the former; the lower fragment is then loosely drawn upward, by the biceps and triceps. Finally, when the fracture is situated at the attachments of the brachialis internus and triceps muscles, the displacement is very slight, because these muscles are inserted in both fragments. The fracture must be very near the elbow, for the displacement which supervenes to resemble that which occurs in dislocation of this region; we shall mention this hereafter. Inflammation of the arm presents nothing peculiar; on the inside of it, we sometimes see red lines, which mark the lymphatic vessels; these elements, also, are inflamed and tense, a common symptom in inflammations of the lower sections of the limb. The arm may be amputated by the circular, or by the flap operation: when the latter mode is chosen, the flaps should be lateral, first, because on the sides, and particularly on the inside, the most important organs are situated, and also in order to have the wound united in an antero-posterior direction, which also is advantageous after the circular operation. The predominance of the antero-posterior diameter of the arm, explains the advantage of an antero-posterior union in this operation, after which, we must always tie the brachial artery, the great collateral artery, and the artery of the ulnar nerve: the small muscular artery is cut in the stump, only when the limb is amputated near the elbow. If called upon to tie the brachial artery, in case of a wound

or an aneurism, we must remember distinctly its triply variable position, relative to the median nerve, which must be taken for a guide: superiorly, we must look for it on the inside of it, and on the outside of the ulnar nerve; in the centre, we must be extremely careful not to touch the median nerve, which it crosses, sometimes before, sometimes behind it: inferiorly, we must always look for it on the outside of this nerve; the ulnar nerve has no longer any relation with it, and cannot be injured. A very important precept in tying this artery readily, is founded on the manner in which it is joined in every part to the inner edge of the biceps, it being situated in the sheath of this muscle.* When we attempt to tie this vessel in the cadaver, we can see the justice of these remarks, at the same time that we find it difficult to perform this operation, if we cut too much on the inside; for then, in order to find the brachial artery in the middle of the arm, we divide the skin, the sub-cutaneous cellular tissue, and the aponeurosis; separate and avoid the internal cutaneous nerve, the basilic vein, the ulnar nerve, and then we find the artery contiguous to the median nerve: farther, we have shown that the course of this vessel may be represented by an imaginary line, drawn from the inner part of the shoulder to the centre of the anterior face of the elbow: in this direction the incisions must be made, when we wish to apply a ligature to the artery. The cautery should be applied to the depression below the deltoides muscle, because in this part there is no deep-seated muscle, the contraction of which, by disturbing the ulcerated surface, might cause pain.

2. REGION OF THE ELBOW.

The elbow is a region formed by the angular union of the second and third sections of the upper extremity.

Its natural limits are vague; farther, we may state that it is formed by all the organs which surround the humero-cubital articulation. Nevertheless, to confine the study within certain limits, and to facilitate the dissection of the elbow, we will say that it commences one finger's breadth above the epitrochlea and extends to two below it.

This region is remarkable for the extent of its transverse diameter; however much the fore-arm may be extended, the elbow always forms an evident angle, which projects backward and is open anteriorly; anteriorly, also, it presents a triangular depression, in which we feel

* Open the sheath of the biceps at its inner part, and you will readily find the brachial artery, in the relations we have stated, with the median nerve.

the pulsations of the brachial artery; it is bounded laterally by two prominences, the external of which is particularly developed; the latter is formed by the fasciculus of the external muscles of the fore-arm, and the other by the pronator teres muscle. The triangular depression of which we are speaking is divided above into two parts, by the prominence of the tendon of the biceps muscle; the external is very distinct, and we see there the median cephalic vein through the skin; the internal is more superficial, and presents the oblique course of the median basilic vein, and it is also remarkable for the pulsations of the humeral artery. Farther, on the outside, the superficial radial vein, and on the inside, the two ulnar veins are very well marked externally; we now have a complete idea of this important face of the elbow.

On the sides of this region, in thin individuals, are the two prominences of the condyles of the humerus, the internal of which is more distinct and more elevated than the external; in fat individuals, on the contrary, we see at the same parts two depressions. Posteriorly we perceive the olecranon process, the position of which varies in the motions of the fore-arm; if we compare it with that of the tuberosities of the humerus which are fixed, we find that in the forced extension, the olecranon rises above them, that it corresponds to them when the arm is semi-flexed, and finally, that it is much below when the arm is flexed at a right angle only, and a fortiori when the flexion is extreme. On the sides of the olecranon process, this face of the elbow is bounded by two depressions; the internal particularly is very much marked; pressure on this part causes pains, which extend to the little finger and the inside of the ring-finger.

Structure.—1. *Elements.* The humero-cubital articulation forms the base on which all the other elements of the elbow are situated; this articulation is strengthened by four ligaments, of which the two latter, particularly, are very strong and very compact, and it is formed by the inferior extremity of the humerus, and the upper part of the two bones of the fore-arm, which are united by a small articulation which blends entirely with it, and which also belongs to the region of which we are speaking. The cavity formed by this small articulation on the side of the ulna is lower posteriorly than anteriorly. We will also state that the humero-cubital articulation is formed in such a manner, and the ulna is fitted so intimately in the pulley of the humerus, that it admits only the motions of flexion and extension of the fore-arm; if we examine the separate motions of the ulna and the radius on the humerus, we observe, in regard to the ulna, that it can only be flexed or extended on the humerus; while the radius is united to the humerus very loosely, so that it rotates upon this bone, and would even incline to the side, if it was not supported by the ulna, which is motionless in

this direction, and which serves as a splint for it. The triceps, the biceps, the brachialis internus, all the external muscles and the posterior superficial muscles of the fore-arm attached to the epicondyle and the outer edge of the humerus, all the anterior superficial muscles of the same region attached to the epitrochlea, these are the organs of motion found in the elbow, and to which they belong but slightly, except the anconeus muscle, most of which is situated there. The aponeurosis of the elbow adheres intimately to the tuberosities of the humerus, and to the olecranon process, and thence extends between the muscles to which it gives points of insertion, forming sheaths for them, which will be described when speaking of the fore-arm. Upward and forward, on the tendon of the biceps, the aponeurosis of the arm is continuous with that of the elbow, most of its fibres bending toward the internal fasciculus of the anti-brachial muscles, and only sending some filaments to the external. In the place where the fibres of this aponeurosis separate in these opposite directions, are two foramina; one through which the external cutaneous nerve leaves its deep position, and soon goes into the thin sheath of the median vein; the other, a little below, which contains an anastomotic venous twig of the superficial and deep veins. The aponeurosis of the elbow is very much strengthened inferiorly, by two expansions; one is stronger and rises from the inner edge of the tendon of the biceps, and goes downward and inward; the other is weaker and rises from the outer edge of the tendon of the brachialis internus, and goes on the external muscular fasciculus of the fore-arm. At the hollow of the elbow, the aponeurosis of its inner face sends toward the anterior part of the tendon of the brachialis internus muscle a layer, which leaves the biceps on the outside, and which forms with the expansion of the brachialis internus above described, a sheath for the tendon of the biceps. The brachial artery terminates in this region, in the centre of the elbow, and, consequently, the radial and ulnar arteries commence here. The radial artery separates from it in the course of a line, supposed to be drawn from this point toward the styloid process of the radius; the ulnar artery in the course of another line, always drawn from the centre of the elbow to the union of the upper with the two lower thirds of the fore-arm. The vessels which only pass through the region, leave there four branches, which are termed the external and internal recurrent radial and ulnar arteries. Two of these are situated on the inside, and are given off by the ulnar artery; two others on the outside, an anterior from the radial artery, a posterior from the dorsal inter-osseous artery. The large and small muscular arteries of the arm, and the artery of the ulnar nerve, also terminate here, anastomosing with the first so as to form around the epitrochlea and epicondyle some arterial circles, which are ex-

tremely important to the collateral circulation. The veins of the elbow are superficial or deep; the latter follow the course of the arteries, each of which has generally two veins; nevertheless, there is frequently only one brachial vein, but always two radial and two ulnar veins. The superficial veins are numerous, and are situated anteriorly; in the normal state, they unite in four principal trunks; an external trunk is formed by the end of the superficial radial vein; one, and often several, which are internal, belong to the anterior and posterior superficial ulnar veins; finally, two middle veins are formed by the median basilic and median cephalic veins, which are formed by the bifurcation of the small median vein of the fore-arm, and anastomose broadly at their origin with the deep radial veins. The lymphatic vessels are very numerous anteriorly and superficially; deeply, they form a small fasciculus on each of the arteries; all go into the axillary ganglions; some of them, the most internal, pass through one or two ganglions which are constantly situated above the epitrochlea. At the base of the hollow of the elbow, on or near the brachial artery, we have also found one or two small lymphatic ganglions.

The nerves of the elbow are divided into sub-cutaneous and sub-aponeurotic; the first are, the filaments of the external cutaneous nerve, which is divided into three branches, then the trunk of the internal cutaneous nerve, which becomes more superficial, the cutaneous branch of the ulnar nerve, and those of the radial nerve. The sub-aponeurotic nerves are the median, the ulnar, and the radial nerves, which divide here into two branches, one of which turns round the neck of the radius below the supinator brevis, while the other is a continuation of the trunk. The cellular tissue is abundant anteriorly, but less exists in the other parts; the sub-cutaneous is very loose posteriorly, and it is lamellar and often replaced by a mucous bursa; this tissue is a little more compact anteriorly, but much more so on the sides, at the condyles of the humerus; but little fat is developed in the sub-cutaneous tissue, except anteriorly: under the aponeurosis, it exists, particularly in the hollow of the elbow, around the vessels, and in the base of the olecranon and the coronoid cavities; in the last two points, it forms elastic cushions. The skin is remarkable only for its fineness, which is seen particularly anteriorly.

2. *Relations.* All this region is surrounded by the skin, which is united to the deep parts; first, posteriorly, by a very loose cellular tissue, or by a mucons bursa; second, by a dense cellular tissue at the tuberosities of the humerus; third, anteriorly, by a cellulo-fatty tissue, which is moderately dense; in this layer, we find in every part nerves, lymphatic vessels, and veins; but most of their trunks are situated anteriorly. The posterior sub-cutaneous nerves are twigs of the radial

and of the cutaneous ulnar nerve; the anterior belong to the external and internal cutaneous nerves; the external cutaneous nerve passes, without dividing, behind the median cephalic vein, to which it is not directly contiguous, as authors assert; the three twigs of the internal cutaneous nerve, after dividing, interlace, on the contrary, around the median basilic vein, which is situated directly upon it. These two veins are directed obliquely inward or outward, to unite with the superficial radial and ulnar veins, which are more external. Next comes the aponeurosis; it surrounds the whole region, like the skin, but differs from it in respect to the septa, which it sends deeply. The aponeurosis being removed, as the relations vary anteriorly, posteriorly, and on the sides, they must be followed successively in these different points; anteriorly, we discover a triangular space, bounded on the outside by the fleshy mass of the supinator and radiales externi muscles, which mass is kept in place by a sheath, where we find also the radial nerve, and the anterior vascular plexus of the epicondyle; this space is bounded on the inside by the fasciculus of the radial muscles, and particularly by the pronator teres, which is divided above, the palmaris longus and brevis placed anteriorly, and the flexor sublimis inferiorly, all of which are retained in a general sheath, where the anterior anastomosing arterial plexus of the epitrochlea is situated; finally, the base of this space is formed by the brachialis internus above, the flexor profundus and the supinator brevis below. The tendon of the biceps separates this hollow of the elbow into two portions; an external, into which pass the radial nerve and the anterior arterial plexus of the epicondyle, which are specially situated in the sheath mentioned; the other, internal, which contains with the anterior arterial plexus of the epitrochlea, the median nerve on the inside, and the brachial artery on the outside. We remark that the brachial artery and the preceding nerve are separated from the median basilic vein only by the aponeurotic expansion of the biceps, but that in descending into the hollow of the elbow, they proceed posteriorly, and consequently separate far from the vein. Posteriorly, the aponeurosis being removed, we find; the tendon of the triceps, the olecranon process intimately united to the aponeurosis, and the upper extremity of the anconeus, extensor carpi ulnaris, extensor minimi digiti proprius, and extensor digitorum communis muscles; finally, under the triceps, the humerus and the posterior ligament of the articulation; under the four muscles of the fore-arm, we find the upper extremities of the radius and ulna, and their superior rotatory articulation; we find, on the inside, first, the depression, bounded by the epitrochlea and the olecranon, to which parts the aponeurosis adheres intimately, thus forming an arch, on which the upper extremity of the extensor carpi ulnaris muscle is partially

attached; second, below this tendinous arch, the ulnar nerve and the posterior arterial plexus of the epitrochlea, then the radiated internal lateral ligament. On the outside, is situated the fleshy mass, which forms the outer side of the hollow of the elbow; this mass is formed from without inward, by the supinator longus, the radialis externus longior, the brevior, and the supinator brevis, under which we find the dorsal branch of the radial nerve, which is directed obliquely downward and backward, and rests almost directly against the bone.

Development. In early life, the tuberosities are slightly marked, the olecranon process, particularly, is lower, whence it follows that the extension can be carried farther than in the adult, and consequently hat the angle of the elbow is not so marked. At the same period, the small sigmoid cavity of the ulna is superficial, and the annular ligament of the radius is much more extensive.

Varieties. When the brachial artery divides prematurely, the ulnar artery frequently does not descend into the hollow of the elbow; it preserves, in the fore-arm, its superficial position under the aponeurosis; it has even been seen directly under the skin. We shall mention these varieties hereafter.

In the female, the accumulation of fat anteriorly, enlarges the elbow in this direction; it is more round than in the male, from the same cause, and also because the lateral muscles project less in her.

Pathological and operative deductions. Wounds of the elbow may be very serious, particularly anteriorly and internally, where the humeral artery is situated. A simple contusion of the posterior part is very painful, because in this part the skin rests directly against the olecranon process, which furnishes a point of support to the acting power: in these cases, we see the importance of the sub-cutaneous mucous bursa; it facilitates the yielding of the skin, which would otherwise be broken: injuries of the olecranon process, or the epitrochlea, affect more or less the ulnar nerve situated between them; hence, another source of the pains which extend toward the little finger; finally, if the external violence be greater, it causes fractures, the olecranon process is particularly exposed to them, and next the epitrochlea. In fractures of the olecranon process, the upper fragment is always drawn upward by the triceps; it is also extremely difficult to keep this fragment near the other, unless the fore-arm is extended; we must, however, remember the angle naturally formed by the elbow, and in applying the bandage we must not carry the extension too far, if we wish to restore the limb to its proper shape, and at the same time to render it as useful as possible, if anchylosis of the elbow occur, as sometimes happens. The humerus may be fractured directly above its condyles; the lower fragment is then very short, and is, as it were,

united with the bones of the fore-arm, and moves with them; it is balanced between two forces, by the traction anteriorly of the brachialis internus and biceps muscles, and by that of the triceps posteriorly; but the superior force of this latter finally draws the olecranon process upward, and causes the fragment which holds it there to vibrate, so that its upper extremity goes forward, and the inferior upward and backward; hence, a prominence of the elbow, similar to that seen in dislocation posteriorly, but which differs from it, as, in this case, the deformity is attended with no change in the normal relation of the three tuberosities. Dislocations of the elbow, which are also termed dislocations of the fore-arm, seldom occur; in order for the bones of the fore-arm to be thrown forward, the olecranon process must be fractured, and then the injury would be severe. The resistance of the lateral ligaments, and particularly the compactness of the articulation, prevent lateral dislocations in a great measure, which cannot supervene, unless most of the ligaments are broken; and notwithstanding the dislocation may be favored by these circumstances, it is generally imperfect.

After dislocation posteriorly, in simple cases, the pulley of the humerus is kept on the summit of the coronoid process, by the tendon of the brachialis internus muscle, which tendon is very much depressed, and which, when the dislocation is overlooked, may ossify, and thus form a new articular cavity, an instance of which was seen by Beclard. In dislocations posteriorly, the humerus sometimes tears the soft parts and projects anteriorly; in these cases, the brachial artery is very liable to be ruptured; dislocation of the radius on the ulna, generally takes place posteriorly, because the edge of the cavity of the latter is lower in this direction; it is frequent in children, in whom the ulnar cavity is rudimentary.

Hydarthrosis of the elbow appears at first posteriorly, on the sides of the olecranon process and of the tendon of the triceps muscle, where the articulation is less supported, and the tumor then rises between the triceps and humerus. Brasdor has proposed to amputate the fore-arm, by disarticulating it in the region of the elbow, and making one anterior flap; this operation is founded on the anatomy of the elbow, since the large trunks of the nerves and vessels, and the largest muscles are situated in this part: the posterior flap would be very thin; in this operation, we must not forget that the articulation is situated one finger's breadth below the epitrochlea, that it is loose on the outside, and that the knife can be introduced in that part only. Dupuytren has advised an ingenious modification of Brasdor's method; it consists in sawing off the olecranon process, which, anchylosing in its humeral cavity, would furnish a fixed point of action, very useful to the triceps muscle. Notwithstanding this process, all practitioners

prefer the operation of Brasdor. Park first attempted the resection of the ends of the elbow, in case of caries; Roux and Dupuytren have also performed this great operation successfully. They always operate on the posterior part of the elbow, where the bones are situated more superficially, and are less covered with important parts. The ligature of the brachial artery requires only the division of the skin, of the sub-cutaneous cellulo-fatty tissue, and of the aponeurosis. We easily avoid the median nerve: it is situated on the inside, and is slightly separated from the artery. Venesection may be performed on all the veins of the elbow; it is free from danger when the superficial radial or ulnar veins are opened; this is not true when the median basilic or cephalic veins are selected, which are generally chosen on account of their size. In bleeding from the median basilic vein, if the lancet be introduced deeply, the brachial artery may be wounded, which is always a very serious accident; if the vein, however, be opened lower down, this risk is avoided, because the artery is there situated much more deeply; when, however, the ulnar artery remains superficial, it may be wounded by a careless physician; finally, numerous filaments of the inferior cutaneous nerve may be wounded in this operation; hence, severe pains, which extend in the direction of these nerves. The brachial artery cannot be wounded, when the median cephalic vein is opened; in this case, can the nerves be injured? this is difficult, unless the lancet is introduced very deeply: in fact, the external cutaneous nerve passes far behind the vein, and is not directly contiguous with it; farther, it is single, which circumstances protect it to a certain point; thus, we must open, if possible, the median cephalic vein. If the brachial artery has been wounded extensively, it must be tied above and below the injury, because the arterial plexuses of the epicondyle and the epitrochlea, which are so important in other cases to re-establish the circulation, would cause the hemorrhage to re-appear; if, on the contrary, the artery is simply pricked, as in venesection, the wound must be compressed, to arrest the hemorrhage, and to cause the formation of a false consecutive aneurism, which can afterwards be cured, by tying the brachial artery above.

CHAPTER III.

THIRD PART OF THE THORACIC LIMB.

This portion of the thoracic limb is composed of the proper anti-brachial region, and of the wrist, which unites it to the hand.

1. ANTI-BRACHIAL REGION.

Properly speaking, the fore-arm is the third section of the thoracic limb; it commences below the elbow, and it is separated artificially from the wrist below, by a circular line, drawn one finger's breadth above the styloid processes.

The form of the fore-arm is conical; its antero-posterior diameter is less than the transverse; this arrangement seems to prepare for the flattening of the hand.

The fore-arm presents two faces, an anterior or palmar, a posterior or dorsal, and two edges, a radial and an ulnar. The palmar face is generally flattened and smooth; the whiteness of its surface contrasts with the other parts of the region; we can trace there the sub-cutaneous veins, which form a plexus, all the branches of which can be followed; finally, above and in the centre, we remark there a longitudinal depression which is continuous with that of the elbow, and which disappears on descending. The dorsal face is convex and covered with a very fine down; we can trace in it the extensor muscles of the fingers when they are contracted. The external edge, in its two upper thirds, is rendered very convex by the projecting of the radiales externi and supinator muscles; it is slightly depressed below this point, then, still lower down, it is elevated by the oblique prominence of the abductor pollicis magnus and extensor pollicis brevis muscles. The internal edge is convex above, less so, however, than the preceding; it is strait below.

Structure.—1. *Elements.* The skeleton of the fore-arm is formed by the central or thin and compact portion of the radius and ulna; these two bones are united by the inter-osseous ligament, which is deficient above, and which presents here and there some vascular openings. The muscles should be distinguished into anterior, posterior,

and external, some of which project out of the inter-osseous space, and others are in a measure contained in it: among the anterior muscles, two only, the pronators, terminate in the fore-arm, the others proceed downward. We will remark that the direction of the two pronator muscles is oblique or transverse, from the ulna towards the radius. The only posterior muscle which terminates in the fore-arm on the ulna is the anconeus muscle; all the superficial muscles, except this, are very long, and have only a few points of insertion in the bones of this region; all the deep muscles, on the contrary, are short, and two of them, the abductor pollicis longus, and the extensor pollicis brevis, are inserted in both of these bones at the same time. The muscles of the external fasciculus are four in number, of which the two supinators are attached by their lower extremity to the fore-arm, while the other two are merely situated in it. The anti-brachial aponeurosis forms a common envelope for all this mass of muscles; it also constitutes some secondary sheaths for many of them. These sheaths are formed by septa which go from the inner face of the aponeurosis toward the bones; they are stronger superiorly than inferiorly, and are firmer superficially than deeply; finally, all proceed from the tuberosities of the humerus. In order to form them, the aponeurosis is attached first on the inner edge of the ulna and posterior edge of the radius, and thus separates the posterior from the anterior and external muscles; it then divides the posterior muscles into two planes, by sending a layer between the superficial and the deep muscles, thus forming, with the bones and the inter-osseous ligament, one sheath for these latter. Each of the deep muscles, on the contrary, has a distinct sheath; this is true of the anconeus, the extensor carpi ulnaris, the extensor minimi digiti, and the extensor digitorum communis muscles. All the external muscles are enveloped in the same sheath, which is continuous posteriorly with that of the common extensor, anteriorly with that of the pronator teres muscle, and is strengthened in the elbow by a detached expansion of the tendon of the brachialis internus muscle; anteriorly, the aponeurosis is arranged very similarly; it divides the muscles into two sections by sending a layer before the flexor communis digitorum sublimis, which layer forms with the bones and the inter-osseous ligament a deep sheath for the two common flexors, and for that of the thumb; the pronator quadratus is always covered by a special layer, which is inserted on the opposite edges of the radius and ulna;* next, each superficial muscle, as the pronator teres, the palmaris longus and brevis, and the flexor carpi ulnaris muscle, is enveloped in a very thin sheath.

* In some animals, particularly in cats, this fibrous layer of the pronator quadratus, is considerably developed.

The fore-arm is supplied with blood by four large arteries, the radial, the ulnar, and the inter-osseous arteries. The first two are the principal arteries; the last are branches of the ulnar artery, which also gives off the small artery of the median nerve. We have mentioned, when speaking of the elbow, the anastomoses which connect the arteries of the fore-arm, and those of the arm; in the fore-arm also, the posterior and anterior arteries are united by the perforating branches of the inter-osseous ligament. The anti-brachial veins are deep or superficial; the first follow exactly the course of the arteries, and each artery has two; the superficial are, the superficial radial, ulnar, and the median veins. These veins are often very distinct in every part; sometimes they all blend below in the posterior and anterior plexuses, and are separated only at the upper part of the fore-arm; the radial and the ulnar veins generally arise posteriorly; they then turn on the edges of the fore-arm and become anterior. The superficial lymphatic vessels follow the course of these veins, and pass before the elbow to open, with the deep lymphatics, into the axillary ganglions. The nerves are superficial and deep; the first come from four sources; the two cutaneous nerves and some cutaneous branches are given off on the inside by the ulnar nerve, on the outside by the radial nerve; the last two nerves, with the median nerve, constitute the deep nervous system of this region. Each nerve sends off some filaments to the adjacent parts; the radial, also, gives off posteriorly a remarkable branch to all the extensor muscles. The sub-cutaneous cellular tissue is moderately loose in every part; the sub-aponeurotic tissue presents nothing special. The fat of the fore-arm is almost exclusively subcutaneous; anteriorly, the skin is whiter, finer, and less downy, than it is posteriorly.

2. *Relations.* The fore-arm is formed by some organic layers, which are more numerous anteriorly and on the outside, than posteriorly and on the inside; farther, some are common to every part, others belong specially to each face. The common layers are; the skin, the sub-cutaneous cellulo-adipose tissue, in which the superficial lymphatic vessels, nerves, and veins, are situated; finally, the superficial layer of the aponeurosis. The deeper layers vary singularly forward, backward, and on the sides, and must be studied successively in these different parts; first anteriorly, under the aponeurosis, we find on the outside the radial artery and its attendant veins, situated in a superficial muscular groove, formed by the approximation of the external and anterior muscles. These vessels follow in every part the course of an imaginary line, drawn from the centre of the elbow in front of the styloid process of the radius; they are attended on the outside by the radial nerve, sometimes as far as the wrist, sometimes

not so far,* according to the height at which it turns. The pronator teres muscle, the tendon of which only is situated under the radial artery, is found in this first layer, with the two palmares and the flexor carpi ulnaris muscle, each of which is enveloped by a special fibrous sheath. A deep aponeurosis and the flexor sublimis muscle form the second layer, below which is a third, formed by the flexor digitorum profundus, and the flexor pollicis longus muscles; but between this and the preceding we find, in the centre, the median nerve and its attendant artery, and on the inside, the ulnar vessels and nerves, situated, first in an interstice, formed above only by the flexor digitorum communis and profundus, while below, on the contrary, it is formed by the approximation of the flexor profundus posteriorly, the flexor carpi ulnaris on the inside, the flexor sublimis and the deep layer of the anti-brachial aponeurosis, on the outside and anteriorly.† In this interstice, the ulnar artery with its veins is directed, first, in a line drawn from the centre of the elbow to the end of the upper third of the inner edge of the ulna. In the first part of its course it is very deep, and is protected anteriorly by all the superficial muscles of the anterior face of the fore-arm; lower down, its direction is parallel to that of the radial artery, and follows the course of a line supposed to be drawn from the epitrochlea to the styloid process of the radius; the ulnar nerve is remote from the artery in the first point, but below, it is contiguous to its inner part and continues so. Behind the flexor digitorum profundus, and flexor pollicis longus muscles, appear the bones, the inter-osseous ligament, and the anterior inter-osseous vessels and nerves, which are concealed inferiorly by the small pronator quadratus muscle, which is also enveloped in its special sheath. Second, *posteriorly*, under the aponeurosis, we find a first layer formed by the extensor digitorum communis, the extensor minimi digiti, the extensor carpi ulnaris and anconeus muscles, all of which are surrounded by a special sheath; below, is a second layer, formed by the abductor pollicis major muscle, the two extensors of the thumb and the indicator, and by a part of the supinator brevis muscle, from which comes the dorsal branch of the radial nerve, which is situated with the posterior inter-osseous vessels, between the two layers which we have mentioned. All these parts being removed, we see the posterior face of the bones and of the inter-osseous ligament. Third, *on the inside*, the aponeurosis

* The nerve is always separated from the radial vessels by a fibrous layer: in fact, the nerve is situated in the sheath of the external muscles of the fore-arm, the vessels, on the contrary, in the anterior sheaths, and particularly in that of the pronator teres above, and of the flexors below.

† The ulnar artery is always situated under the deep layer of the aponeurosis of the fore-arm; hence, to reach it from before backward, we must pass through two fibrous layers.

adheres directly to the bone, which is situated alone under it in every part, except inferiorly, where we find the dorsal palmar branch of the ulnar nerve, a branch which turns under the flexor carpi ulnaris muscle, and on the inner edge of the fore-arm, at a height which varies. Fourth, *on the outside*, under the aponeurosis, we come into a large aponeurotic sheath, in which are situated the radial nerve, the supinator longus, the radialis externus longior and brevior, and the supinator brevis muscles; above, these four muscles are superimposed from without inward in the preceding order, and below the latter, on the neck of the radius, is situated the dorsal branch of the radial nerve. In the centre of this edge of the fore-arm we find, on the outside of the bone, only the supinator longus and the radiales externi muscles; lower down, the tendons of these three muscles are crossed obliquely and superficially by the abductor pollicis longus, and the extensor pollicis brevis muscles, which come from the posterior face of the fore-arm; finally, near the thumb, these last two muscles and the supinator longus cover only the course of the radial nerve, which is oblique posteriorly.

Development. The fore-arm is the second part of the thoracic limb which is formed distinctly. Before the period of puberty, the sub-cutaneous fat is so abundant anteriorly, that the whole region has a rounded form.

Varieties. This region presents numerous anatomical varieties. The palmaris brevis muscle is often deficient; the flexor pollicis longus muscle often sends, in front of the ulnar artery, a fasciculus toward the epitrochlea or toward the coronoid process, &c.* The aponeurotic sheaths are sometimes more numerous than usual, and are never deficient; we not unfrequently find a special sheath for each of the external muscles, &c. When speaking of the brachial region, we have mentioned the varieties in the origin of the principal arteries in this region, in consequence of the premature division of the brachial artery; in these cases, the inter-osseous artery arises sometimes from the radial, sometimes from the ulnar, and even from the brachial artery. Sometimes the ulnar artery does not occupy, superiorly, its normal deep position; we have seen this variety several times in the following degrees: first, as in Plate VII., a very small twig is detached from the brachial artery, and may pass on the fasciculus of the epitrochlear muscles, and after passing a short distance, penetrate into the ulnar interstice, to anastomose with the ulnar artery, which has its normal arrangement; second, sometimes this twig is as large as the ulnar artery, which may then be considered as arising by two roots, a superficial and a deep root. We have always seen the first pass under

* We consider this to be the normal arrangement of the flexor pollicis longus muscle, but ention it as a variety, only to conform to the general opinion.

the aponeurosis; Meckel says that it may be sub-cutaneous; we are more inclined to believe this, as the rudimentary twig, which forms the first degree of this variety, frequently divides into two twigs, the one sub-cutaneous, the other sub-aponeurotic, as is seen on Plate VII.; third, finally, the whole ulnar artery may pass superficially, and be situated in its interstice, in the centre of the fore-arm. The radial artery often gives off its radio-palmar branch very early; then, also, it often turns very soon under the supinator longus muscle, and goes to the dorsal face of the fore-arm. We have once seen the small artery of the median nerve continuous with the brachial artery; the radial and ulnar arteries were rudimentary, and contrasted with the great size of the first.

In the female, the sub-cutaneous fat retains in the fore-arm the characters of infancy.

Uses. The fore-arm has been called, and very justly, the handle of the hand, *manubrium manus.* In fact, the hand is constantly rotated with it, sometimes forward, pronation, sometimes backward, supination: these motions are favored particularly by the breadth of the inter-osseous space.

Pathological and operative deductions. The fore-arm may be entirely deficient, and the hand may exist; in this case, the development is simply arrested. In an individual who died recently at the Hospital St. Antoine, only the upper extremity of the fore-arm existed; there was no scar as evidence that an amputation had been performed; we saw only the skeleton; the upper extremity of the two bones of the fore-arm could be easily distinguished; the head of the radius, however, was deformed. In fractures of the fore-arm, the inter-osseous space is more or less completely effaced by the converging of the loose extremities of the fragments of the bones; this converging is caused by the action of the muscles of this space. If we examine this displacement, particularly when the radius is fractured, we see that on account of the mobility of this bone in its upper and lower articulations, the two fragments come together toward the ulna. When the ulna, on the contrary, is fractured, the inferior fragment alone deviates toward the radius; the upper is too immoveable in its humeral articulation to follow the same course. In these fractures, as the inter-osseous space is important, and it is impossible to unite the fragments in any other manner, we must crowd the anterior and posterior masses of muscles between the bones, which are thus pressed from within outward, following a direction opposite to the action of the displacing powers; in order to this, we must make the antero-posterior diameter of the fore-arm larger than the transverse, by means of pyramids of compresses placed in this direction. It is easy to tie the radial and ulnar

arteries in wounds, if we cut upon the course of the lines mentioned: the radial artery must be raised from without inward, and the ulnar artery in the opposite direction, to avoid their attendant nerves. The radial artery may be tied in every part, but the ulnar artery cannot be tied, in its upper fourth, without great trouble. Where one of these arteries is affected with aneurism, on account of the large anastomoses situated in the hand, we must tie it above and below the tumor, or rather we must place one ligature on the brachial artery. The fore-arm may be amputated at any part; most of the vessels to be tied are situated in the anterior part of the stump, or in the anterior flap; they are, the radial, the ulnar, and the anterior inter-osseous arteries; the posterior inter-osseous artery is the only one from which hemorrhage comes posteriorly. Union by the first intention, after this operation, seems to us less suitable than when the arm is operated upon, for two reasons: first, on account of the great number of tendons which form the stump, particularly at the lower part; second, on account of the very strong fibrous sheaths, which surround the muscles; they form canals, and are always ready to receive the pus or blood which are necessarily effused under the wound, in parts where the ligatures are situated; hence, abscesses are formed, which interrupt the progress of nature in cicatrization. When wounds of the upper and external part of this region penetrate to the bone, they are necessarily complicated with the injury of the radial nerve, and consequently with the paralysis of the posterior muscles of the fore-arm, the extensors of the hand and fingers. This accident is also attended with the flexed position of these parts, which obey the unequal action of their flexor muscles.

2. REGION OF THE WRIST.

The wrist is the point where the fore-arm unites with the hand; this region commences above, where the fore-arm terminates, and is bounded below and forward by a curved line, which corresponds to the pisiform bone on one side, but it is more depressed on the outside; finally, this line, if continued, will terminate the lower boundary.

The wrist is flat, like the fore-arm; its transverse diameter is more extensive than the antero-posterior.

This region presents two faces; the anterior or palmar face, is flat; we distinguish there some blueish lines, which anastomose in a plexus, and an elongated prominence; the first are the sub-cutaneous veins, the second marks externally the fasciculus of the extensor tendons; two transverse folds also exist in the wrist; they are caused by the flexion of this part; the pulsations of the radial artery may be felt

there above on the radius ; this is also the place selected for counting the pulses. The posterior or dorsal face is convex ; we see there, particularly near its edges, the very marked prominences of the veins ; in extension only, certain tendons are very much marked, and we distinguish particularly, that of the extensor pollicis longus, which descends obliquely on the outside ; finally, the head of the ulna also forms on the inside and backward a remarkable eminence. Of the two edges which separate these faces, one is external or radial, the other is internal or ulnar ; the first presents above a convexity, which belongs to the inferior and enlarged part of the radius ; while below, in the abduction and extension of the thumb, we remark there an oblong depression, at the base of which the pulsations of the radial artery may easily be perceived ; the lines which circumscribe this depression belong on the outside to the tendons of the great abductor and short extensor of the thumb ; on the inside, to its great extensor. The second edge of the wrist is concave ; it is the base of the angle, formed by the union of the inner edges of the hand and fore-arm ; we easily feel there the styloid process of the ulna.

Structure.—1. *Elements.* The radio-carpal and inferior radio-cubital articulations form the centre of this region ; the first is constituted on one side by the two bones of the fore-arm, particularly the radius, and on the other, by the first range of the carpus, except the pisiform bone ; it is strengthened by four ligaments, which are not very compact. The bones of the fore-arm contribute to form this articulation by a cavity ; the bones of the carpus unite and form, on the contrary, a convex surface ; on the whole, the line of the articulation describes, from the styloid process of the radius to that of the ulna, a slight curve, convex superiorly. The second articulation is formed simply by the head of the ulna and the sigmoid cavity of the radius ; it is kept in place by a fibro-cartilaginous layer, which is often imperfect. We find here the tendons of a great many muscles ; anteriorly, are situated those of the flexor digitorum communis, the flexor pollicis longus, the flexor carpi ulnaris, and of the palmaris longus and brevis muscles ; posteriorly, those of the extensor digitorum communis, the extensor carpi ulnaris, and of the radiales externi muscles. The portion of the aponeurosis which surrounds this region is continued on the hand and fore-arm ; it is very strong, particularly posteriorly, where its transverse fibres are very visible, and constitute the posterior annular ligament of the carpus. Its internal face adheres intimately to the external and internal edges of the radius and ulna, and sends some prolongations, which partially surround the tendons, especially those of the extensors, forming for them, with the bones, some osseo-fibrous sheaths, where some very moist synovial membranes are

situated; these sheaths are very numerous posteriorly, and they there form one which is common to the two radiales externi muscles; another, which is oblique, and contains the tendon of the extensor pollicis longus; a third, which belongs to the tendons of the extensor communis and the extensor indicis proprius muscle; a fourth, for the extensor minimi digiti muscle: the latter is entirely fibrous, and corresponds to the space between the radius and ulna; on the outside, the tendons of the extensor brevis and of the abductor pollicis longus muscle have a common sheath, and the extensor carpi ulnaris, on the inside, possesses a special sheath. The radial and ulnar arteries are the principal arteries of this region; they pass through it, and give off in it some twigs. At the wrist, the radial artery divides into two branches; one the radio-palmar, and the other the dorsal, which turns on the outside, and which is regarded as the continuation of the principal trunk. The ulnar artery, also, sends on the back of the wrist a branch which is very small, and which cannot therefore be considered as the continuation of the trunk. The nutritious arteries of the wrist form two plexuses, by which the two principal trunks are united; one of these anastomotic plexuses is anterior, and extends along the lower edge of the pronator quadratus muscle; the other is posterior, and is formed by the dorsal artery of the carpus, and the dorsal twig of the ulnar artery; the anterior inter-osseous artery of the fore-arm terminates in both of these arches, which thus form around the wrist a very remarkable vascular bracelet. The deep veins attend the arteries, and are always in pairs; the superficial form a plexus, the branches of which are larger on the back than anteriorly: here we find the origins of the median vein of the fore-arm, there those of the superficial radial and ulnar veins. The lymphatic vessels of the wrist present nothing peculiar; those of the outside go into a small ganglion, placed on the back of the wrist, and termed the supra-carpal. The nerves are deep or superficial; the first are trunks of the median and ulnar nerves, which only pass through this point; the second are the radial nerve and the dorsal twig of the ulnar nerve, posteriorly; anteriorly, and on the sides, the cutaneous nerves of the fore-arm. The cellular tissue of the wrist is loose posteriorly; it is more dense anteriorly; but ittle fat exists there; the skin is finer and smoother anteriorly than posteriorly.

2. *Relations.* The wrist is covered with the skin, which is more adherent anteriorly than posteriorly; under it we find, in the sub-cutaneous tissue, the superficial lymphatics and veins; anteriorly, the end of the cutaneous nerves of the fore-arm; posteriorly, and on the sides, the end of the radial nerve, that of its cutaneous twig of the fore-arm, and the dorsal branch of the ulnar nerve. Finally, we find more

deeply the aponeurosis, below which the relations vary anteriorly, posteriorly, and on the sides. Anteriorly, the radial artery and the radio-palmar artery, which is continuous with it; the tendons of the two palmares and of the flexor carpi ulnaris appear first; under them, those of the flexor digitorum communis sublimis, which conceal the median nerve and its artery; then the flexor profundus and the flexor pollicis proprius; next the anterior arterial plexus and the articulation. On this face and near the inner edge of the region, the tendon of the flexor carpi ulnaris on the inside, that of the flexor digitorum communis on the outside, the flexor profundus and the pronator quadratus posteriorly, form an interstice, where the ulnar vessels are situated, to the inside of which the ulnar nerve is contiguous. At the posterior part of the wrist we find, on the same plane, all the tendinous sheaths and their tendons in the order mentioned above; that of the extensor pollicis longus crosses below and superficially the tendons of the radiales externi muscles; finally, the end of the inter-osseous artery always passes through the sheath of the extensor digitorum communis muscle. Under the aponeurosis we always find, on the outside, the united tendons of the long abductor and short extensor of the thumb; below the artery, the radial nerve, and the articulation; on the inside, on the contrary, the extensor carpi ulnaris, the dorsal branch of the ulnar nerve, and also the articulation.

Development. Until the age of eighteen years the thumb presents but a slight degree of resistance, because the lower epiphyses of the radius and ulna are not fused with the bones.

Varieties. This region is subject to numerous varieties. We have seen there one large artery, following the direction of the median nerve, the radial and ulnar arteries being rudimentary. The radial artery also often divides before coming to this region. In these cases, sometimes the two branches do not separate as in the normal state, sometimes the dorsal, which may be considered as the trunk of the artery, turns prematurely, and the pulsations which are felt in the usual place are those of the radio-palmar twig, and not those of the trunk of the radial artery.

Uses. The region of the wrist presents motions of two kinds; some belong to the radio-carpal articulation and are very extensive, being performed in every direction; others occur in the radio-cubital articulation, and are confined to the rotation of the radius on the ulna, the ulna being fixed. In these motions, the radius and the hand are intimately united, and always rotate together; their position varies, and thus causes the states of supination and pronation. This latter, produced by the rotatory motions forward, which are the most extensive, may be carried very far.

Pathological and operative deductions. Anterior wounds of the wrist are the most serious. Like those which affect the other parts of this region, they may be complicated with the division of certain tendons, and also some large nervous and vascular trunks may be divided: the radial artery also may be cut in wounds made outward and a little backward. In distinguishing fractures of the radius, we take advantage of the fact that this bone must rotate with the hand; we rotate the hand and also the lower fragment of the fracture, and thus we obtain the crepitation. Dislocations of the wrist are rare when the development is perfect; sprains of its principal articulation are much more common. The small head of the ulna may be dislocated on the radius, which generally takes place posteriorly, on account of the extent of the motions. Hydarthrosis of the wrist forms a tumor which first raises the layer of the tendons, and afterwards projects above their sides. Dropsy of the synovial sheaths of the wrist constitutes ganglions, which are frequently seen posteriorly; a tumor of this kind sometimes forms anteriorly, in the sheath of the flexor tendons: it then glides under the anterior annular ligament of the carpus into the hand, and seems strangulated before the wrist. It is dangerous to open these tumors, on account of the inflammation which is caused, and the adhésions which follow and necessarily impede the motions of the part: this operation, also, when imprudently performed, may cause caries of the carpus. In the resection of the wrist, we must follow the advice of Roux, and operate on the lateral and posterior parts of the region: in this manner, we divide but very few vessels and tendons. In amputating the wrist at the joint we must make an anterior flap, which is more vascular and better nourished than that which can be made posteriorly: in order to disarticulate it rapidly, we may place the knife under the styloid process of the radius, and then make the incision according to the course of the articular curve. This operation has succeeded several times, but sometimes the tendinous sheaths, which remain open, carry the pus to the fore-arm: it always requires the ligature of the radial, ulnar, and end of the inter-osseous arteries.

CHAPTER IV.

OF THE HAND.

Considered generally, the hand* may be defined, the loose extremity of a limb divided into fingers, one of which may be opposed to the others.

The fourth section of the thoracic limbs in man is a species of the hand, for it presents all its characters, and as in him it possesses them exclusively, man is termed bimanous.

In man, the hand is remarkably flat, which increases its surface of touch; it is destitute of hairs anteriorly, and is concave in this direction; the hairs which it presents on its posterior face, form only a slight down; it presents two edges, a radial and an ulnar. The upper extremity is united to the fore-arm by the wrist, from which it is distinguished anteriorly, by a natural line already mentioned. The loose extremity is divided into five fingers, which will be described separately.

The texture of the hand seems combined to render it very sensible and very moveable; its upper or carpal part is slightly developed, its digital extremities, on the contrary, are very much so; one of them is detached from the others.

In the female, the hand is smaller; more fat is found on its dorsal face than in the male, and its form is consequently more beautiful.

The uses of the hand are numerous, and depend on its sensibility and mobility. As a sensible part, it is the most perfect organ of touch; its motions also serve for the exercise of this faculty, and also for taking or for preparing food; among the motions of the hand there is none more important to its functions than that of opposition, in which the thumb and its metacarpal bone are detached from the other fingers and proceed to meet them.

* The loose section of the limbs presents in animals numerous varieties, in respect to its uses and formation. Considered in the first point of view, this part serves sometimes for a *fin*; sometimes a *wing*; sometimes a base of support, a *foot*; sometimes it becomes an organ of prehension and of touch, a *hand*. In respect to its formation, it is sometimes simple, sometimes, on the contrary, it is divided into fingers, of which there are never more than five. These segments may be situated on the same plane and fixed, or one of them, which is detached from the rest, may be more moveable and capable of being opposed to them; the loose part of a limb, modified as in this latter case, is a hand. Men and apes are the only animals provided with them.

In respect to its functions, and also its structure, the hand is composed of two very distinct regions, the palmar and the digital. We will examine them successively.

1. PALMAR REGION.

The palm of the hand is its undivided portion of which it forms more than the upper half. It presents two faces; the anterior is generally concave and forms the hollow of the hand: this face is bounded on the outside and inside by two prominences; the external, termed the thenar, belongs to the muscles of the thumb, the internal, termed the hypo-thenar, marks externally the fasciculus of the muscles of the little finger. Three curved grooves, which are often united by others which are smaller, exist on the anterior face of the hand; one superior, the concavity of which is directed upward and outward, a second, inferior, the arrangement of which is directly opposite; finally, the central is almost concentric with the first; the former is caused by the opposition of the thumb; the second, by the forced flexion of the last four fingers; the latter, by that of the palm of the hand. Finally, four eminences, which are more or less callous, like the posterior part of the hypo-thenar, correspond to the heads of the last four metacarpal bones. The other face of the palm of the hand, the posterior or dorsal face, is convex; we see there the tendons of the extensors of the fingers, and also the bluish lines of the superficial veins, and on the outside, near the wrist, we can feel the pulsations of the radial artery. The external or radial edge is continued by the thumb, it is convex and less extensive than the internal, which has the same general form, and on which we feel, above, a prominence which belongs to the upper extremity of the fifth metacarpal bone.

Structure.—1. *Elements.* The skeleton of the palm of the hand is formed by the carpal and metacarpal bones; the whole of this skeleton is so arranged, that it forms an arch concave anteriorly, which is destined to protect the minutest organs; the joints are secured by strong ligaments, and represent the supports of this palmar arch; among these attachments, the inferior transverse metacarpal is particularly remarkable; it embraces only the heads of the last four metacarpal bones; at the metacarpus, the bones are separated by the interosseous spaces. The muscles of the palm of the hand are intrinsic or extrinsic; the latter are situated on all the faces of the region, and extend there from the fore-arm; they are the common extensor of the fingers, the special extensors of the little finger, of the index finger, and of the thumb, the extensor carpi ulnaris and the radiales externi

muscles, on the posterior face ; the flexor communis sublimis and profundus, the flexor pollicis longus, the two palmares, and the flexor carpi ulnaris, on the anterior face ; the abductor pollicis longus, on the outside. The intrinsic muscles are all situated anteriorly or in the metacarpal spaces ; some go to the thumb, and form the prominence of the thenar ; they are, the abductor pollicis brevis, the flexor brevis, the opponens pollicis, and the abductor ; the others belong to the eminence of the hypo-thenar and the little finger ; they are, the palmaris brevis, the adductor minimi digiti, the flexor brevis, and the abductor minimi digiti ; finally, others occupy an intermediate point, and belong to all the fingers, except the thumb ; they are, the lumbricales and the inter-ossei muscles, the position of which is indicated by their name. The two faces of the palmar region are protected by an aponeurosis, which is continuous above with that of the wrist, and terminates below at the roots of the fingers ; its dorsal portion is very thin and is attached to the extensor tendons, between which it is situated ; its palmar portion is very resisting in the centre, but is feeble on the prominences of the thenar and hypo-thenar ; in the first point, it receives the expansion of the tendon of the palmaris longus muscle, and thence goes radiating to the metacarpo-phalangean extremity of the palm of the hand, and then divides into four slips, which terminate separately on the head of the last four metacarpal bones, which are included between their bifurcation ; the slips of this aponeurosis are united below by some transverse fibres, which renders this part remarkably strong ; the anterior annular ligament of the carpus is attached to it but slightly ; it forms with the carpus, an osseo-fibrous sheath for the tendons of the flexor muscles, and also protects the other parts of the hand by its strong resistance. Another palmar aponeurosis, which is not described by authors, is extended deeply on the inter-ossei muscles and the deep palmar arch of the hand, and is continuous with the inferior transverse metacarpal ligament. The arteries of the hand terminate the arterial system of the thoracic limb ; they arise from the ulnar and radial arteries on the sides, from the inter-osseous artery in the middle, and from the artery of the median nerve ; these last two, in the normal state, are not very important. The arterial system of the palm of the hand is formed by two arches, one superficial, the cubito-radial, the other deep, the radio-palmar, the first is formed particularly by the ulnar artery, and the second by the radial ; they are situated anteriorly, and are formed by broad anastomoses of the radial and ulnar arteries ; the radial artery deviates towards the back of the palmar region of the hand, in order to distribute to it some twigs which are necessary to its nutrition ; it then returns immediately to the inner face of the hand, to which it is distributed. The veins of the palm of the hand do not

attend the arteries; there are, however, two large radial veins, which form a deep double arch; but in the course of the superficial arterial arch, we find hardly one rudimentary vein. The veins of this region are situated principally on its back, where they form a plexus, the origin of the superficial ulnar and radial veins. The lymphatic vessels are arranged like the veins; they are numerous on the back and under the skin, and but few exist deeply on the course of the arteries. The palmar nerves are given off by the median, the ulnar, the radial, and the two external and internal cutaneous nerves of the fore-arm; some of these nerves are cutaneous, and others deep-seated. The skin receives some filaments from the two cutaneous, the median, the ulnar, and the radial nerve, which terminates there with its cutaneous filament of the arm. The trunks of the median and ulnar nerves are the only deep-seated nerves.

The cellular tissue of the palm of the hand is loose, and slightly adipose, posteriorly; it is, on the contrary, very compact anteriorly; it contains numerous adipose vesicles at the eminence of the hypothenar, and at the heads of the metacarpal bones; in these different points, also, the fat is situated in fibrous canals, one extremity of which is attached to the skin, the other to the aponeuroses; these canals are rudimentary in man, but are much more developed in those animals which rest in standing on the thoracic limbs. The skin of the anterior face of the hand is thicker than that of the back; it often becomes callous in those parts which are constantly exposed to pressure.

2. *Relations.* The relations of the palm of the hand, in order to be properly understood, must be examined successively on its two faces.

1. *Anterior face.* This must be divided into three secondary sections; that of the thenar, of the hypo-thenar, and of the palm of the hand.

At the eminence of the thenar, we find successively, a fine skin, which is not callous; an adipose cellular tissue, in which is a plexus of superficial veins, and some filaments of the external cutaneous, and frequently of the radial nerve; a thin aponeurotic layer; the abductor pollicis brevis muscle, through which the radio-palmar artery passes above; the opponens pollicis, and a fasciculus of the flexor brevis, which muscles are separated near the thumb, by the external collateral artery of this finger; the tendon of the flexor pollicis longus muscle; the second fasciculus of the flexor pollicis brevis; the first metacarpal bone; the external part of the carpus; and the tendon of the flexor carpi radialis muscle, which is situated in the groove of the trapezium.

At the hypo-thenar eminence, the skin is thick and callous above: it covers a dense fibro-cellular layer, which attaches it to the aponeu-

rosis, and in the centre of which are situated three or four fasciculi of the palmaris brevis muscle, some filaments of the internal cutaneous and ulnar nerve, the internal collateral nerve and artery of the little finger; more deeply is situated, a fibrous layer, which is stronger than that of the thenar eminence; then, on the same plane, the adductor and flexor brevis minimi digiti muscles, and the origin of the superficial palmar arch, which is adjacent on the inside to the ulnar nerve; inferiorly, the opponens muscle, through which the deep branch of the ulnar artery and of the nerve passes above, and finally, the fifth metacarpal bone.

In the centre of the anterior face, the skin is callous above, and it rests below on a very dense cellulo-fatty layer, in which ramifies a filament of the median nerve, and by which it is united to the most resisting part of the palmar aponeurosis, which comes next; this aponeurosis conceals above, the anterior annular ligament of the carpus, below, the superficial palmar arch, and the trunks which come from it; farther behind this fibrous layer, are situated, the collateral nerves of the fingers, and the end of the median and ulnar nerves, the tendons of the superficial flexor muscle, then those of the deep flexor, which are separated by the lumbricales muscles, which parts are united by a very loose lamellar tissue, and frequently by a prolongation of the mucous bursa of the carpus; below this fasciculus, we find a fibrous layer, situated on the deep palmar arch, the deep branch of the ulnar nerve, and the last palmar inter-ossei muscles; finally, on the outside, the abductor pollicis muscle, through which the radial vessels pass, and which are contiguous to the first two inter-ossei muscles, being separated from them by an interstice, in which the collateral vessels of the thumb and index finger ramify.

2. *Posterior face.* The relations of the posterior or dorsal face are very simple, and are formed by the successive super-position of the following layers: the skin, which is fine and slightly downy; a loose cellular tissue, which presents but little fat, and in the centre of which ramify many superficial veins and lymphatic vessels, and also the radial nerve, the dorsal branch of the ulnar nerve, and the cutaneous brachial filament of the former; the dorsal aponeurosis, and the extensor tendons which are situated on the same plane; more deeply, upward and outward, the tendons of the radiales externi muscles; then below them, the radial vessels, the dorsal twigs of the carpus and metacarpus, all of which are covered by the tendons of the preceding muscles; finally, the back of the carpus, the metacarpus, the muscles which fill the metacarpal spaces, and the arteries which pass through them, particularly the radial artery, to establish anastomoses between the posterior and anterior arterial systems of the palm of the hand.

Uses. The palm is the most solid part of the hand; this supports the weight of the body in some rare cases, where the thoracic limb serves as a column of support, or to repel obstacles; we then can form an idea of the advantage derived by the position of the vessels and nerves in the carpo-metacarpal groove; they are also protected very perfectly by two strong ligaments, the annular and the palmar aponeurosis, which prevent in every direction the collapse of the arch which it forms; the external form of the palm of the hand enables it to hold liquids, which may be kept in its anterior depression, the depth of which can be increased by the contraction of the muscles of the hypo-thenar, and particularly by the palmaris brevis, which contraction is combined with the opposite motion of the first metacarpal muscle.

Pathological and operative deductions. Wounds of the palm of the hand are not very serious, when made posteriorly and externally, provided the radial artery be uninjured; but those of the anterior face, especially if made by a pricking instrument, are extremely severe, on account of the texture of this part; numerous vessels and nerves also, may there be affected, as we have seen; and farther, the intimate adhesion of the skin to the palmar aponeurosis, and the very great resistance of the latter, may prevent, in superficial or deep wounds, the swelling or inflammation from taking place freely, and consequently a strangulation may be produced, which may cause severe pain, and mortification of the deep parts. Wounds under the aponeurosis, even if very simple, often cause the tendons to adhere to each other, and impede the motions; in the most severe cases, pus forms in the sheaths of the tendons, and if not soon discharged, it burrows under the annular ligament to the wrist, and even to the fore-arm. We often find pus in the palm of the hand, although no primitive affection of this exists; it comes there from the sheaths of the fingers, the mucous bursæ of which often extend into this region. The skin of the palm of the hand, by its dryness or moisture, by its heat or cold, often presents pathologists with remote but constant symptoms of deep diseases.

The laxity of the dorsal cellular tissue of the palm of the hand, explains the facility with which it is infiltrated, in diseases of the thoracic limbs, while the contrary is true of the anterior face. Different operations may be performed on the palm of the hand; a part of it may be amputated in the articulation of the carpus with the last four metacarpal bones, as has been proposed by Maingault. This operation is successful on the cadaver, and the disarticulation is performed rapidly, if we take as a guide the prominence of the outer edge of the hand which has been mentioned. It has also been proposed to amputate a part of the hand in the articulation of the two ranges of

the carpus; the extirpation of the whole hand is preferable. The first and fifth metacarpal bones may easily be extirpated, with the finger which they support; the latter operation is the more difficult, on account of its double articulation with the carpus and the fourth metacarpal bone. Roux was the first to remove a metacarpal bone, preserving the corresponding finger; he performed this operation successfully on the left thumb of a tailor. The radial artery may be easily tied on the back of the carpus, and the ulnar artery on the anterior part of it, if necessary, as is proved by the position of these vessels.

The fingers are often flexed, on the palm of the hand, by old cicatrices, which are frequently caused by burns improperly treated; they must be cut to their base, taking care, however, to avoid the tendon, the tension of which varies; the finger must afterwards be flexed, if it was previously extended on the back of the palm of the hand, and must be extended, if its direction was that of flexion; finally, it must not be left to itself until the cicatrization is completed. By this mode of treatment, the finger recovers all its motions.

2. DIGITAL REGION.

The fingers are the terminating appendages of the hand. Of these, there are five, separated by intervals more or less deep, but which never extend the whole length of the fingers. They are termed by different names: the first is the thumb, the second the index, the third the middle, the fourth the ring, and the fifth the auricular or little finger. The length of the fingers varies; the longest is the middle finger, next comes the ring finger, then the index finger, the thumb, and the little finger. They vary much, also, in size: the thumb is the largest; next come, successively, the middle, the index, the ring, and the little finger.

The direction of the fingers is varied by their motions; they are situated on the same plane, except the thumb, which is the most anterior, and can become still more so in certain cases. This arrangement of the thumb, on which, with other circumstances, depends its opposition, forms the special character of the hand. The fingers are slightly flattened from before backward; considered externally, we distinguish in them four convex faces, and two extremities. The anterior face is the most depressed: it is remarkable for some transverse folds, which are very prominent in flexion; these folds correspond more or less exactly to the articulations, and it is important to determine them with precision. The highest, which is often double, extends six lines below

the metacarpo-phalangean articulation; the middle, which is generally double also, corresponds exactly with the first phalangean articulation. The third is generally single, and is situated a line and a half above the union of the second and third phalanges. The middle groove is deficient in the thumb, on which, however, we find three folds anteriorly; but the highest belongs specially to this finger, and corresponds exactly to its metacarpal articulation. The dorsal face of the fingers is entirely rounded; we see there, as in the anterior face, some grooves, which correspond more exactly than the preceding to the articulations; in flexion of the fingers, three angular prominences appear on this face, the summit of which does not correspond to the articulations, but is situated in every part one line above. The lateral faces are nearly plane, and present only the continuity of the anterior and posterior grooves. The upper or palmar extremity is attached: the last four fingers are united at its level by a membrane, a prolongation of the skin of the palm of the hand; it is a remnant of that which unites them as far as the nail, in the fetus. This inter-digital membrane forms the base of the inter-digital angle, which is six lines distant from the level of the metacarpo-phalangean articulation, whence it follows that the fingers are blended above with the palm of the hand. The thumb is entirely loose at its base; the base of the groove, which separates it from the index finger, is situated at its metacarpal articulation. The loose or ungual extremities of all the fingers are rounded, and present an elastic prominence, remarkable for the arrangement of the papillary eminences of the skin, which there circumscribe some concentric ellipses; posteriorly, we find the nail, a quadrilateral layer of horny substance, produced by the skin, and situated in a very marked groove of this membrane, the matrix of the nail. The base of this groove, which is seen very distinctly in Plate VIII., Figure 3, is formed by the place where the derma of the skin is reflected, to go from the superficial to the attached face of the nail; in this groove, the latter is very thin and cutting.

Structure.—1. *Elements.* The structure of the fingers is very simple, and extremely important; their skeleton is formed by long bones, the phalanges, of which each finger has three, except the thumb, the central phalanx of which is deficient. These bones are termed the phalanges, phalangini, and phalangettii. The articulations which unite these bones with each other, or with the metacarpus, are strengthened by three ligaments; two of these are lateral, and are situated nearer the direction of flexion than that of extension; an anterior, which is enlarged and semi-cartilaginous, and in which one or two sesamoid bones are frequently developed, forming pulleys for the flexor tendons of the fingers, and the uses of which may be

compared to the patella. Each finger is covered, posteriorly, by a fibrous membrane, formed by the expansion of the tendons of its extensor muscles, to which, in the last four fingers, the lumbricales muscles are added. Some fingers, as the thumb, the index, and the little finger, have two extensor muscles. Two lateral muscles, an abductor and an adductor, also terminate on each finger. The two deep flexor muscles send to them some tendons, which in the last four fingers are interlaced in such a manner, that one of them, that of the superficial, divides, to allow that of the deep to pass: these tendons terminate on the last two phalanges, and are attached to the first only by some vascular and synovial filaments, and not by a fibrous expansion, as has been asserted; they are enclosed in an osseo-fibrous canal, which proceeds from the metacarpo-phalangean articulation to that of the phalangini and phalangettii; this canal is formed, posteriorly, by a groove in the phalanges, and at the articulations by their anterior ligament; it is composed, on the contrary, in its anterior three fourths, by a fibrous membrane, continuous above with the transverse and inferior metacarpal ligament; it is very strong at the central part of the first and second phalanx, and it is interrupted in some other parts: this membrane is formed of transverse fibres in those parts where its resistance is slight, but at the first and second phalangeal articulations it is reduced to two oblique fasciculi, which are crossed crucially. This arrangement, which is generally but little known, causes four large openings; two anterior, through which the synovial membrane is seen, and two others which are lateral, through which the vessels penetrate. Two narrow and very rounded foramina are constantly situated on the sides of the metacarpo-phalangean articulation, at the origin of the fibrous sheath: they contain two arterial filaments: finally, a very moist synovial membrane is doubled on its parietes, and on the tendons which it protects. Two arteries pass laterally, and a little anteriorly, through each finger; they are the collateral arteries, which are often enlarged by some dorsal twigs from the metacarpus. These arteries come from the palmar arches, and particularly from a trunk situated in the space between two contiguous fingers, which trunk bifurcates at the metacarpo-phalangean articulation. At the end of the finger, these vessels become entirely anterior; they anastomose in the pulp by arches, from the convexity of which proceed some anastomosing branches, which are also in arches, and which then terminate. Some filaments leave these collateral arteries at the articulations; they go backward, and terminate in the posterior soft parts; of these twigs, the latter is larger than the others, and forms with that of the opposite side an arch, which surrounds the attached extremity of the nail. The arrangement of the digital veins differs entirely from

that of the arteries: no one, hitherto, has described or figured them satisfactorily; it is difficult to inject them, on account of their numberless anastomoses, into which the injection flows, when it is arrested by the valves: we have, however, a fine preparation, which is figured in Plate VIII., Figures 1 and 2; the principal twigs of these veins are situated on the back of the finger, where they form a slightly complex plexus. They arise, on the contrary, on its anterior face, by numerous roots, which form a fine plexus, the meshes of which represent quadrangular figures: this anterior plexus communicates with the posterior by three principal branches, situated on the inside and outside of the digital articulations: we sometimes find, in the course of the collateral arteries, a very small vein, which never exists the whole length of the finger, but only at the metacarpo-phalangean articulation. Most of the lymphatic vessels, like the veins, are dorsal. There are four nerves for each finger; two palmar, and two dorsal. They are termed collateral, on account of their position; they have been wrongly described as anastomosing in arches at the extremity of the fingers. The median and ulnar nerves give off the palmar; the median to the thumb, the index finger, the middle finger, and the outer part of the ring finger; the ulnar, to the inner side of the ring finger, and to the little finger. The end of the radial nerve and a branch of the ulnar nerve give off the dorsal, which are also distributed to the fingers, so that the median nerve on the outside receives a filament of the radial nerve, and another from the ulnar nerve on the inside. The skin of the fingers is fine and very papillary, especially in the direction of flexion; it is extremely tense in every part, and it is united anteriorly to the fibrous sheath by some dense cellular filaments, in the spaces between which, many very minute adipose vesicles are situated: the dorsal cellular tissue is looser and less adipose than in the other points.

2. *Relations.* The relations of the elements of the fingers are extremely simple, and must be considered successively, anteriorly, posteriorly, and laterally. In the first direction we find, in successive layers; the skin, an abundant cellular and adipose tissue, attaching the skin, intimately to the deeper parts and containing in its areolæ some very minute arteries, the anterior venous plexus, the branches of which are almost sub-cutaneous; more deeply and at the pulp only, we find the arterial arch and the anterior collateral arteries: then below, the phalangettean flexor tendon, and the phalangette, the extremity of which is rough, and on which are attached some cellular filaments which adhere on the other hand to the skin. (See Pl. VII. fig. 3.) At the first two phalanges, the skin and sub-cutaneous tissue being removed, we find the sheath of the flexor tendons, presenting the

openings we have mentioned, and contiguous on the outside to the collateral vessels and nerves, the nerve being situated on the outside, and the artery on the inside; we perceive some arterial filaments, which penetrate into the openings of the sheath, surrounded with adipose bodies, which establish a communication between the external cellular tissue and that concealed by the sheath. If we open this sheath, we see the tendon of the superficial flexor, and then that of the deep flexor; but they soon cross, this relation changes, and the latter becoming superficial covers in its turn the former. If we raise these tendons, we see that they adhere to the sheath in some parts by bands, which are shown by injections to be formed of vessels covered by the synovial membrane. Beyond, we see the anterior face of the phalanges and of their articulations. On the dorsal face, the elements of the fingers are arranged much more simply and appear in the following order: the skin, its sub-cutaneous cellular tissue, which is looser and less adipose than anteriorly, and in which we find the dorsal venous plexus, the small dorsal arteries, and the dorsal collateral nerves: more deeply comes the aponeurosis of the extensor and lumbricales muscles; finally, the phalanges and their articulations, which are open in this direction. At the phalangette, under the skin, we find the arterial arch, which sends numerous branches into the matrix of the nail and into the skin reflected under it. The parts which cover the skeleton of the fingers on the sides are, the skin, a sub-cutaneous cellular tissue, similar to that which exists posteriorly, and containing the dorsal arteries, the oblique veins which unite the anterior venous plexus with the posterior; above, the tendons of the inter-ossei and lumbricales muscles.

Development. The period when the inter-digital membrane, mentioned above, begins to disappear, has not been accurately determined; Meckel states that it is at the third month of fetal existence. In the child, the canal of the flexor tendons is formed only by the phalanges, the anterior groove of which is deficient; as age advances, the osseous part of this passage increases progressively, at the expense of the fibrous membrane.

Varieties. The vessels and nerves of the fingers are sometimes given off by trunks, arranged abnormally in the palm of the hand: but if the fingers receive the nerves and vessels necessary for the support of their vitality and their sensibility, it is of little importance whence they come, provided these elements always have the same relations.

Uses. The functions of the fingers are to execute extensive motions of flexion and extension in all their articulations. Motions of adduction and abduction belong only to the metacarpo-phalangean articulation. The pulp of the finger is admirably adapted to be a most perfect

organ of touch; it is supplied with numerous nerves, the skin is attached there very firmly to the bones, and supported by a very elastic fatty cushion, to which the phalangette and the nail serve as a point of support.

Pathological and operative deductions. All or some of the fingers are sometimes united in the adult in the same manner as in the fetus, by a prolongation of the skin. Whether this defect be congenital, or produced by treating a burn improperly, it is always remedied by a simple incision. Supernumerary fingers have sometimes the normal structure; but most generally they are normal only in their external form: they are simple fleshy excrescences. The fingers are dislocated only anteriorly and posteriorly; they are, in general, easily reduced; we, however, have seen Dupuytren find it very difficult to reduce a metacarpo-phalangean dislocation of the thumb, which was not reduced till the cause of the difficulty had been discovered by an incision to be the gliding and interposition of a portion of its small flexor tendon between the articular surfaces.* Wounds of the fingers, particularly of the anterior part, are always very painful; if made with a pricking instrument they may be followed with violent inflammation, resulting from the imperfect injury of some nervous filament. Inflammation of the finger is termed panaris: it may be situated exclusively in the skin, in the sub-cutaneous tissue, in the tendinous sheath, in the periosteum of the phalanges, or it may affect all these organs at the same time. Deep inflammation is very serious; the least symptoms which it can cause are, the loss of the flexor tendons, and even of the phalanges, which may die. A very remarkable circumstance is, that after necrosis, the bone is never reproduced. Superficial inflammations, if not attended to very soon, may become deep, from the vascular and cellular continuity of the parts. The abundance of the nerves, the compact nature of the skin of the finger, particularly its intimate adhesion to the bones, and its tension, which prevents it from yielding, explain the extreme pain, the fever, and the severe symptoms often seen in these diseases. To remove these pains and the compression, Boyer recommends that the part be laid open before pus forms, but other surgeons advise us to wait. When the suppuration is superficial, we must always be careful of the sheaths of the tendons; but they must be opened as soon as pus enters into them. We cannot tell, a priori, whether pus be or be not contained in the sheath; hence, in the first incision, this must be avoided; we afterwards examine with a director,

* Pailloux has made some researches, from whence it would seem that the interposition of the anterior ligament of the articulation, between the articular surfaces, is one of the principal obstacles to the reduction of dislocations of the fingers: this seems to us more probable, as this ligament is the place where the sesamoid bones are formed. Pl. VII.

to ascertain whether this presents any fistulous openings, and if this be the case, we must open it, in order to prevent the pus from burrowing in its canal towards the hand, which is a serious accident. These attempts, however, must always be made gently, and we must not forget that natural openings may be, and have been, mistaken for fistulous passages; this error is very serious, as having opened the sheaths the tendons exposed to the air constantly exfoliate: this is followed with the loss of the motion of flexion and with a permanent state of extension. This latter inconvenience always attends a panaris if situated in the tendon. We have often observed, that after the first extension of a finger, which has lost its flexor tendons, a forced flexion supervenes. Dissection has shown us that this secondary phenomena results from the coarctation and collapse of the useless sheath. Superficial panaris is sometimes situated only in the matrix of the nail, which then is often separated, although it re-appears, if the skin be not deeply affected. The wasting of the end of the finger, in persons affected with phthisis, removing from the loose extremity of the nail its point of support, this nail curves slightly in the form of a hook. Dropsy of the tendinous sheaths of the fingers is not unfrequent; it is marked externally by two tumors, which correspond to the weak parts of the fibrous membrane. We have dissected a cadaver where the fingers presented anteriorly numerous small lipomata. The fingers may be amputated or extirpated: amputations are generally performed in the phalangean articulations; two flaps may be made, an anterior and a posterior, or only an anterior. The position of the vessels and nerves is not a sufficient reason for making, as has been proposed, two lateral flaps, which would be opposite according to the great diameter of the osseous surface. Whether we divide the dorsal or the posterior face, we can judge of the importance of our remarks on the relations of the cutaneous grooves with the articulations: if no posterior flap be made, and if we commence the incision posteriorly, we must cut one line below the articular angle: if, on the contrary, we commence anteriorly, the incision must vary. After amputation in the phalangeal articulation, the stump may be flexed by the phalangean tendon of the superficial flexor. This tendon, on the contrary, is divided in amputation at the first joint, and the motions of flexion of the small stump are lost, until adhesions of the tendons with the cicatrix restores the action of their flexor muscles: we have seen this several times: the synovial adhesion of the superficial tendon with the first phalanx would not be sufficient to produce the flexion of the stump. We have a finger amputated at the first phalangeal articulation, on the summit of which a small unciform nail had formed. The fingers are easily extirpated, if we remember the depth of the articulation: we make two

small lateral flaps, in which the nerves and the veins are situated; we must be careful to cut very near the finger which is to be amputated, in order to avoid the common trunk of the collateral arteries, situated at the height of the metacarpal articulation.

SECTION II.

OF THE ABDOMINAL LIMBS.

The abdominal or pelvic limbs are articular prolongations of the abdominal or pelvic portion of the trunk.

In the animal series, these limbs are less constant than the thoracic; they are deficient only in the large mammalia, the cetaceous animals, and particularly the whale, &c. They form the posterior limbs of quadrupeds, the claws of birds, and the ventral fins of fishes.

In man, the length of the inferior limbs measures nearly half the whole length of the body; in this respect they are a little less than the thoracic limbs, which depends upon the fact that one of the faces of their last section, the foot, rests on the ground, and consequently extends the length of the limb only by its height; they are separated by the breadth of the pelvis, and are placed upon an anterior plane.

The mass of the pelvic limbs is considerable. Their form is nearly conical; and in order to study them, they must be considered as standing parallel to each other; in this position they present an anterior face, which is generally convex, and a little depressed at the first joint; a posterior face, which is also convex, particularly in the centre, and in certain positions; their outer part forms in the centre a re-entering angle; the internal forms, on the contrary, an angle more or less prominent in the corresponding point. Each of these lateral faces is marked by three eminences, on the outside the great trochanter, the external condyle of the heel, and the external malleolus; on the inside, the sciatic tuberosity, the inner condyle of the knee and the internal malleolus; the first are situated on the same line, but this is not true of the second. The base of the pelvic limb rests on the pelvic trunk and blends with it, so as to contribute on the inside to circumscribe one of its splanchnic cavities, the abdomen; its summit rests on the foot, which serves as its base of support.

Structure. The structure of the abdominal limb is characterized by the strength and length of the bones, the solidity of the articulations,

the resistance of the aponeuroses, the number and size of the muscles, the development of the different kinds of vessels, while the nerves, compared with the size of the limb, are not large, and the skin is thick.

Development. The development of the abdominal limbs is connected with that of the abdominal part of the trunk, and as this part is the most constant, these limbs are seldom deficient in monsters; their formation, however, is irregular; although the abdomen is the first part seen in the fetus, the limbs which proceed from it are slow in their development, particularly if compared with the thoracic limbs.

Varieties. In the female, the pelvic limbs are proportionally larger and longer than in the male; in her, also, their size depends on the abundance of the sub-cutaneous fat, which renders them more round.

Uses. In the lower limb, every thing is calculated for solidity, but at the expense of mobility: the insertion of the muscles in the levers which they move is less oblique than in every other part, and the latter are frequently of the second kind; finally, the compact nature of the articulations also explains these two results, which are necessary to the functions of the limb, as it must constantly support the weight of the whole body.

Pathological and operative deductions. The whole of the abdominal limbs are seldom deficient, as has already been explained. They are sometimes united, and extend the trunk in the form of a tail, in the monsters termed sirenes. The solidity of their articulations renders their dislocations unfrequent, although their functions, in fact, dispose to them; this circumstance, on the contrary, is very favorable to fractures. The great resistance of the aponeuroses renders deep inflammations more serious here than in any other point.

The four great divisions of this limb are, the haunch, the thigh, the leg, and the foot, which sections are united by joints, the upper of which blends with the haunch, while the other three serve as the base of important regions.

CHAPTER I.

FIRST SECTION OF THE ABDOMINAL LIMB.

The first section of the abdominal limb, the haunch, is the base by which it rests on the trunk. It is composed of the organs which cover the two faces of the iliac bone; the haunch is analogous to the shoulder in the thoracic limb, and presents two faces; one is internal, and corresponds to the abdomen, and blends with its parietes, in which we have already examined it; the other is external, and is directly connected with the pelvic limb, and forms on the outside the gluteal region, while anteriorly the region of the thigh advances to it. From this external face, which is common to two regions, proceeds the coxo-femoral articulation, remarkable for its depth, which is increased by a fibro-cartilaginous bursa, and is strengthened, first, by an inter-articular ligament, which is attached to the iliac bone, at the base of the cotyloid cavity; second, by a capsule, very strong above, on the outside, and anteriorly, and weak in other directions; a considerable adipose body fills the base of the articulation, and communicates with the extra-articular tissue, through a fibro-osseous foramen, situated on the inside, and serving also for the introduction of an important artery, which distributes some ramuscules to the round ligament, and to the head of the femur. Finally, a part of the femur is modified for this articulation, and presents for this purpose its head, and pedicle or neck, which is directed upward and inward, and forms with the rest of the bone an angle of about one hundred and twenty degrees, which is open downward and inward. This neck may be divided into three portions; an inter-articular, an extra-articular, which is very much marked posteriorly, and a third, which is represented by the line of insertion of the fibrous capsule.

Development. The first section of the abdominal limb is developed at a late period, and seems to be the last which is distinct in the fetus; during the whole of pregnancy, it is in a measure rudimentary; after birth, it increases slowly but constantly, until puberty, at which period the sexual characters are seen.

Varieties. In the male, the haunch is thrown slightly outward, and is considerably high; the opposite is true of the female. In respect to their arrangement, numerous individual varieties exist; in

some males, they are very much separated, as in the female; while in some females they are remarkably near: sometimes the round ligament is completely absent, which may depend on an old rupture.

Pathological and operative deductions. The position of the coxo-femoral articulation on the limits of the haunch and thigh explains how its diseases may extend into one or the other of these regions, or in both of them, as is seen in dislocation for instance. This dislocation, taking into view the structure of the articulation, seems practicable only downward and inward; and yet, observation demonstrates, that dislocation upward and outward is much more common. A fact of this nature can depend only on an anatomical arrangement; Gerdy seems to me to have placed the cause of it correctly in the round ligament. In motions of adduction, this inter-articular fibrous fasciculus raises from the base of the cotyloid cavity, the head of the femur, around which it tends to rotate; in this manner, the summit of the head of the femur is soon placed on the edge of the cotyloid cavity, and only a slight muscular effort is necessary to produce dislocation. The neck of the femur may be broken in the three parts which have been mentioned; hence, three distinct kinds of fractures of this neck; some are external to the articulation, and are easily consolidated, the two fragments receiving numerous vessels; others, which correspond to the insertion of the fibrous capsule, unite equally well, for the same reason, and are particularly remarkable for the slight displacement of the fragments; the last, which are entirely intra-articular, are never cured, because the upper fragment being almost destitute of vessels, becomes a foreign body in the articulation, and therefore cannot contribute to the formation of callus; this condition of the upper fragment explains why it is frequently destroyed by the friction of the lower fragment. A want of union in this latter case has been observed by every person, and the facts have led several distinguished surgeons, particularly Sir Astley Cooper, to state, that this fracture never unites. Although this opinion is founded on an immense mass of facts, several cases have been mentioned which at first view would seem to contradict it; but we are strongly led to believe, from what we have gained by dissecting ten cases of the fracture of the neck of the femur, that this difference of opinion arises from not distinguishing the three kinds of fractures we have mentioned. We have now before us four femurs, where the neck has been broken above the insertion of the capsule, and not the least consolidation exists in any one of them. It cannot be objected that this fact depends on the advanced age of the subjects whom we have examined; in fact, one of them was only thirty-three years old: farther, we know very well that some fractures of the neck of the femur are perfectly consolidated in old men. The objection which

some make who speak of the vessels received by the superior fragment through the round ligament, is not well founded; to judge of it, we must consider the fineness and thinness of these vessels, which many seem to admit theoretically rather than by direct examination. The spontaneous luxation of the coxo-femoral articulation is often produced in children by a tuberculous swelling of the cotyloid cellulo-fatty body. In one case dissected by us at the Hospital des Enfans, we found on the inside of the cotyloid cavity a tuberculous mass, which communicated with a similar production, situated on the outside, on a level with the internal foramen of the articulation; this external tumor seemed to have extended from the inside to the outside, by the continuity of the cellular tissue. After these different luxations of the femur, the head of this bone may go to different parts; we shall mention this hereafter, and also the supplementary joints which take place in this case. We have now to examine the cotyloid cavity; when freed from the head of the femur, it at first contracts, becomes triangular, the cotyloid bursa tumefies for want of pressure, fills the whole cavity, which is soon obliterated by the approximation of its parietes, like an alveolus, after the tooth is extracted.

The first part of the abdominal limb presents on the inside, the iliac and intra-pelvic regions, which we have already mentioned; on the outside, it is formed by the gluteal region, and unites to the second section of the corresponding limb.

GLUTEAL REGION.

The buttock is the upper and outer part of the haunch. It is bounded above by the iliac crest; below, by a depression, termed the groove of the buttock; anteriorly, by the great trochanter and the superior and anterior iliac spine; posteriorly, by the sacrum, by the coccyx, and at their level, by a depression, which is continuous with that of the spinal region of the trunk.

The thigh rests by one side on the pelvis, on the other it is cutaneous, and is more or less uniformly convex; we can often see there, and can feel there below, a depression, bounded by two large tuberosities of bone, those of the ischium, and of the great trochanter.

Structure.—1. *Elements.* The skeleton of the buttock, is particularly, the internal iliac fossa, and the upper external part of the coxo-femoral articulation, which has been examined in describing the haunch generally, because it belongs equally to the two regions which proceed from it, the gluteal and the femoral. Below this articulation, a large tuberosity of the femur, the great trochanter, belongs to this

region, in which the skeleton presents also two osseo-fibrous foramina, termed the sciatic, one of which, the larger, is upper and posterior; another, which is smaller, inferior and anterior; both establish a communication with the buttock and the interior of the pelvis. Three great muscles belong to this region, and are termed the glutei muscles; they are distinguished according to their size. In regard to the texture of these muscles, we would remark, that the terminating tendon of the gluteus maximus is flattened, and expanded in thin layers on each of its faces; that of the gluteus medius is central, while that of the gluteus minimus is expanded on its external face only. The small rotator muscles of the thigh are all situated deeply in the buttock; the pyramidalis, the two gemelli, the extremities of the obturators, and the quadratus femoris; finally, a very small portion of the biceps, semi-tendinosus, semi-membranosus, triceps, and adductor longus muscles, advance into this region, to which they are entirely accessory. The fascia lata aponeurosis arises in the buttock, and presents there some special characters; it is very thin posteriorly; anteriorly, on the contrary, it is very strong, and gives origin to the gluteus medius muscle; it is attached to all the periphery of the buttock, and, in fact, forms for it an imperfect sheath, open downward toward the thigh, and upward on the side of the pelvis, at the sciatic foramina. The fascia superficialis also extends into this point, and soon disappears in the cellular tissue. The arteries of the buttock come almost exclusively from the hypogastric artery, the gluteal branch of which belongs to it; the internal pudic and sciatic arteries pass through this region, and send to it some branches, particularly the latter. All these vessels come from the pelvis, through the great sciatic foramen; the pudic artery alone passes through the small sciatic foramen. Finally, the two circumflex arteries retrograde, and terminate there by anastomosing with the proper gluteal arteries; this circumstance is extremely important in re-establishing the circulation, when the upper part of the femoral artery or the external iliac artery has been tied. The veins generally follow the course of the arteries; we, however, remark, that we find a superficial plexus of them, which is sometimes large, and goes to the sub-cutaneous abdominal vein. The superficial lymphatic vessels go to the ganglion and groin: the deep follow the course of the gluteal and sciatic arteries, enter into the pelvis, and go to the pelvic ganglions. The gluteal nerves are distinguished into the superior gluteal, which are given off by the lumbo-sacral cord, and the inferior, which come from the sacral plexus; the great sciatic nerve, the internal pudic nerve, and the small sciatic or posterior cutaneous nerve of the thigh, pass through this region, giving to it some twigs; like the arteries, they all come through the great sciatic foramen, some

passing above the pyramidalis muscle, and others below it. The deep cellular tissue of the thigh is fatty; it is very loose, and is continuous above, through the sciatic foramina, with the intra-pelvic tissue, and below, with that of the posterior part of the thigh. The superficial cellular tissue is entirely different and distinct from the former; it is remarkable for its density, and for the fat which it contains, which varies in quantity; some fibrous filaments pass through it, and increase its resistance. The gluteus maximus muscle is separated from the great trochanter by a mucous bursa, which is remarkable for its laxity, and the septa which separate it. The skin of the buttock is fine, and slightly downy, except on the posterior limits of the region.

2. *Relations.* In regard to the arrangements of its elements, the buttock is extremely simple; they appear in the following order: the skin, the sub-cutaneous cellulo-fatty layer, which is more abundant at the sciatic tuberosity, then the very strong aponeurosis, anteriorly; more deeply, on the same plane, the gluteus maximus, and most of the gluteus medius, the whole of which, however, is not seen until the former is divided; under this latter, we find, also, beside the vessels and nerves which belong to it, the deep portion of the gluteus medius muscle, and the sacro-sciatic ligaments, the pyramidalis muscle, the sciatic vessels and nerves, resting from above downward, on the gemellus superior, obturator internus, gemellus inferior, quadratus femoris, and the adductor longus, and situated in a depression, formed on the inside by the sciatic tuberosity, which is exposed with the muscles which are inserted in it, and on the outside, by the great trochanter, on which we perceive the mucous bursa of the gluteus maximus, and the upper extremity of the vastus externus muscle. With the sciatic vessels and nerves, which come from the pelvis, through the great sciatic notch, below the pyramidalis muscle, we find the internal pudic vessels and nerves, which soon leave the former, and re-enter into the pelvis through the small sciatic foramen, embracing in an angle the sciatic spine. Under the gluteus medius muscle we find, above, the iliac fossa; below, the gluteus minimus muscle, separated from the gluteus medius by the principal branches of the superior gluteal vessels and nerves, particularly by an anastomotic arch, formed between the gluteal artery and the external circumflex artery. Finally, if we remove the gluteus minimus, with the muscles attached to the trochanter, we discover the upper and posterior parts of the coxo-femoral articulation. The quadratus muscle, particularly, covers the tendon of the obturator externus, and the ascending and anastomotic branch of the internal circumflex artery.

Development. In very young children, the buttock projects but

slightly; and yet, the quantity of fat, in proportion to the development of the muscles, is very great.

Varieties. In the female, the buttock is much more rounded than in the male; in the latter, the sciatic tuberosity and the trochanter, and the groove between them, are developed in the highest degree. The prominence of the buttock varies in different individuals; the most curious of these varieties is undoubtedly that presented by the female Housoanas, a tribe of Hottentots; it consists in a local obesity of the buttock, which has been confounded, but improperly, with the apron.

Uses. The buttock is formed principally by a group of muscles, which act very powerfully in standing erect; hence the general uses of this region, which are much less developed in animals who have a horizontal posture than in man, in whom it forms one of his specific characters.

Pathological and operative deductions. Whatever may be the cause which produces dislocation of the head of the femur upward and outward, it is drawn up by the action of the gluteal muscles, and glides on the external iliac fossa, below the gluteus minimus muscle, the insertion of which bounds its displacement; the thigh then becomes more convex upward, and more flattened downward. If the dislocation remains unreduced, the head of the femur, left to itself, presses on the periosteum of the iliac bone; hence the vessels collapse, and consequently the corresponding parts of the bone waste; phenomena which may be considered as the origin of the accidental cavity, which forms after a certain time; we add, that the surrounding periosteum tumefies, and throws out a coagulable matter, which changes successively into cartilage, and then into bone, and forms, by fusing with the bone, of which it is an accidental epiphysis, the edge of the new cavity. We have found flat and lenticular bodies, of a semi-cartilaginous consistence, developed in the mucous bursa of the gluteus maximus muscle. The pus of gluteal abscesses may be produced by a disease of this region; it may also come there from the thigh, or from the pelvis, passing through the great sciatic foramen; they have already been mentioned. Erectile tumors and aneurisms are sometimes developed in the buttock, under its muscles; they are too deep to admit of treatment; in one case of this kind, Dr. Stevens, of St. Croix, has tied the internal iliac artery with success, a difficult and hazardous operation, which has already been mentioned when speaking of the iliac and costo-iliac regions. Some cases of sciatic hernia have been described; in all cases mentioned, the tumor was discerned with difficulty externally, and was always covered by the gluteus maximus muscle. The position of this tumor, in respect to the sciatic

vessels and nerves, has never been mentioned; from the anatomical arrangement of the parts, we may suppose that it glided before them, and that it was enveloped with them posteriorly; on account of this arrangement, Cooper directs us, if the case presents itself, to divide the strangulation anteriorly. No person has mentioned the direction in which the external incision should be made; on the cadaver, it is very easy to come to the sciatic ring, by cutting in the groove of the buttock, following the oblique direction of the lower edge of the gluteus maximus muscle, which is raised above; after this period of the operation, we find the sciatic vessels and nerves, which must be avoided.

CHAPTER II.

SECOND PART OF THE ABDOMINAL LIMB.

The thigh is the second section of the abdominal limb; its limits are more exact superiorly than inferiorly; by uniting upward and forward with the abdominal wall, it contributes to form the groin, which has already been mentioned. At its lower part, on the contrary, it forms one of the elements of the knee; hence the two regions, the crural region, and that of the knee.

1. CRURAL REGION.

The crural region is distinguished from the buttock upward and backward by the groove of the buttock, and from the abdominal wall upward and forward, by the groin; while on the inside, a groove filled with follicular openings, and which corresponds to the ascending ramus of the ischium, separates it from the external genital region; below, it is, in fact, blended with the knee, and they can be separated only artificially, by a line drawn circularly four fingers' breadth above the patella.

The thigh has the form of a truncated cone, the base of which is situated in the pelvis, and the summit in the knee; it is slightly flattened in an opposite direction superiorly and inferiorly; its direction is oblique from above downward and from without inward; its length measures nearly a quarter of that of the whole body.

The thigh, although generally rounded, presents some prominences and depressions, most of which are muscular; thus, in leaning, the relief of the sartorius muscle is seen proceeding from the anterior and superior part toward the internal; another prominence leaves the pubis and descends backward and outward; it is formed by the fasciculus of the adductor muscles, and circumscribes, with the preceding, a triangular depression, the inguinal hollow, in which we readily feel the pulsations of the crural artery. The anterior and external faces of the thigh are more or less generally convex, on account of the special direction of the femur, and also of the size of the fleshy masses which cover it. The internal and posterior faces are less convex than the first, for an opposite reason; in the centre of the internal face, we can feel, by pressing firmly, the pulsations of the crural artery, which rests almost directly on the femur. On the posterior face appears the fasciculus of the posterior muscles, which fasciculus is at first single and directed obliquely outward, and then separated into two secondary fasciculi, which contribute, as we shall see, to form the popliteal space.

Structure.—1. *Elements.* The femur forms the skeleton of the thigh; it belongs to it almost solely by its centre, which is arched anteriorly and perfectly compact; the direction of this bone is that of the whole region; all its motions, in its upper and lower articulations, are performed by superficial and deep muscles; the first extend the whole length of the thigh, and even beyond this; the second are much shorter; among the deep muscles we will mention particularly, the triceps which directly covers the femur, the fibres of which are very much shorter than those of the superficial muscles; most of the other muscles are situated inward and backward; but few exist, on the contrary, outward and forward. In the latter points we find only the tensor vaginæ femoris, the rectus femoris, and the sartorius, while on the inside, the mass is much larger, and is formed by the gracilis and the adductor muscles, which are four in number, if we include the pectineus* muscle; posteriorly, we see the biceps, the semi-membranosus, and the semi-tendinosus, which may be considered as the cords of the arc represented by the femur. The psoas and iliacus muscles anteriorly, and the gluteus maximus posteriorly, send their lower extremities to this part.

A very firm aponeurosis covers all these muscles, to which it sends remarkable sheaths, which are formed by the septa given off from its inner face, and which terminate in the linea aspera of the

* The pectineus muscle has the position, form, direction, structure, and uses of the other adductors.

femur. The crural aponeurosis, or the fascia lata, is continuous upward and backward with that of the buttock, upward and forward with the crural arch, and below this, with the fascia iliaca on the outside, while on the inside, it is attached to the external lip of the pubic arch; finally, this aponeurosis is continuous below on the knee. The strongest sheath of the muscles of the thigh is that common to the triceps and the rectus femoris muscles.* The sartorius, the adductors, the gracilis and pectineus muscles, have separate sheaths; one alone envelopes posteriorly the deep muscles, vessels, and nerves; this posterior sheath continues upward under the buttock to the sciatic notch; below, it communicates with the popliteal space. The femoral vessels are also provided with a triangular sheath, which is very strong and very broad above, where it constitutes the crural canal, which will be described minutely when speaking of the relations of the crural region; finally, the sheath of the psoas and iliacus muscles continues, like these muscles, to the thigh, where it ceases to be formed by the iliac fascia. Several openings in the fascia lata give passage to vessels and nerves, which sometimes from deep become superficial, but much more frequently have the opposite arrangement. The most remarkable of these openings is that of the internal saphena vein at the base of the crural canal.

Most of the crural arteries come from a common trunk, situated successively on the anterior, internal, and posterior faces of the region, and which passes through it in the course of a line drawn from the centre of the crural arch toward the posterior and internal part of the inner condyle of the femur. In the normal state, this trunk gives off from its upper part an inch and a half below the Fallopian ligament, a considerable branch, which is often as large as itself; this is the deep crural artery, which becomes deeper as it descends, and gives off most of the special arteries of the thigh; first, the two circumflex arteries, which embrace the neck of the femur and then go toward the buttock, in which they anastomose with the gluteal arteries, while the internal alone, at the obturator foramen, unites broadly with the obturator artery. The two circumflex arteries form, on the respective limits of the thigh and of the pelvis, a complete arterial circle, which unites the systems of both regions, and which may supply the principal trunk in this part: second, the perforating arteries, which may also be called the posterior crural arteries, and which, in fact, from their origin, all go backward and form, by terminating in two branches, an anastomosis, between the arteries of the buttock and those of the knee, an arrangement highly important to the collateral circulation. The deep femoral

* Sometimes the rectus femoris is contained in a special and very thin sheath.

artery nourishes the inferior and posterior parts of the thigh, while the external and anterior parts receive a considerable branch, given off by the femoral artery at its external and upper side; this branch is the external muscular artery, the origin of which varies very much.

The veins of the thigh follow the course of the arteries in almost every part; nevertheless, in this respect, they must be divided into sub-aponeurotic and sub-cutaneous; the first may exclusively be said to attend the arteries; the arrangement of the second is entirely different. Among the sub-aponeurotic veins, the deep crural vein commences by anastomosing with the external saphena in the popliteal space, as is seen in Pl. XVI.; the superficial veins also form a fine sub-cutaneous plexus, all the branches of which converge inward and go into the femoral portion of the internal saphena vein, which also receives above, the superficial veins from the costo-iliac and testicular regions, while it is generally united also with the external saphena vein by a considerable branch of the latter, which goes obliquely towards it. The internal saphena vein is situated successively on the inside and at the anterior part of the thigh, in proportion as it ascends; finally, above, it passes into a special foramen of the fascia lata aponeurosis, and terminates in the crural vein.

Numerous lymphatic ganglions occupy the inguinal hollow, some of which are superficial and others deep; the term sub-aponeurotic applied to these latter is correct only in part, because they are situated only in the sheath of the femoral vessels, (the crural canal:) consequently they are simply covered by a very thin layer of the fascia lata, and are not situated entirely below it. The superficial ganglions of the inguinal hollow receive all the superficial lymphatic vessels of the corresponding limb, those of the testicular region of the perineum, of the haunch, and of the sub-umbilical part of the costo-iliac region. The deep ganglions receive the deep crural lymphatic vessels. The nerves of the thigh come from the sacral or lumbar plexuses; the latter supply its anterior, internal, and external parts, the branches of the former go exclusively to the posterior face of this region: all are superficial or deep; the superficial nerves on the outside are the inguino-cutaneous branch; inward and forward, the genito-crural and some filaments of the crural nerve; internally and anteriorly, the genito-crural, and some filaments of the crural nerve; posteriorly, the small sciatic nerve, the posterior cutaneous nerve of the thigh. The deep nerves are three; the great sciatic nerve, which merely passes through this region and gives off no filaments; the crural and the sub-pubic, which resolve themselves into a great many branches, nearly all of which go exclusively to the thigh, except the internal saphena branch of the first, which goes to the parts below. In respect

to position and destination, the sciatic nerve is posterior, the crural is anterior and external, the sub-pubic or obturator is internal.

The sub-cutaneous cellular tissue of the thigh is abundant anteriorly and internally; it is moderately loose; the sub-aponeurotic tissue is very abundant posteriorly, around the sciatic nerve; the superficial and deep fat presents the same arrangement as the cellular tissue, and is more abundant under the skin than in any other part. Finally, the skin of the thigh is generally thick and resisting, but it presents these properties particularly anteriorly and on the outside; internally and posteriorly, it is proportionally remarkable for its fineness and smooth appearance.

2. *Relations.* The skin, the sub-cutaneous cellulo-fatty tissue, and the superficial fold of the fascia lata, form three layers, which are common to the whole thigh; the nature of these layers has been mentioned in the preceding article. We will only remark, that the sub-cutaneous cellulo-fatty tissue contains all the nerves, the superficial lymphatic vessels, and some lymphatic glands superiorly; that the internal saphena vein is situated internally and anteriorly with its branches, particularly with that which comes from the external saphena; finally, we must not forget, that among these different sub-cutaneous, nervous, and vascular ramifications of the thigh, the nerves proceed from above downward and perforate the aponeurosis superiorly, from within outward, and proceed into the layer which principally belongs to them; while the lymphatic vessels and the veins have an entirely different course; they ascend and penetrate upward, under the aponeurosis, through special openings.

Below the fascia lata aponeurosis, the organic layers of the thigh are not so distinctly marked, and especially they are not common to its whole circumference; hence, the relations must be examined successively, anteriorly, posteriorly, externally, and internally.

1. Anteriorly, the relations also differ, according as they are considered superiorly or inferiorly. In the first point, the aponeurosis being removed, we see a triangular depression, the base of which is situated at the crural arch, and its summit at the place where the sartorius and the first adductor muscle cross; while its outer edge is formed by the first of these muscles, and the internal by the second; in this space, we find the femoral vessels, in the course of a line drawn from its summit to its base; these vessels are arranged in such a manner, that the vein is on the inside superiorly, and then glides posteriorly; the trunk of the crural nerve is soon divided into numerous branches, is contiguous to these vessels on the outside, but it is separated from them by a very dense fibrous layer, for it is situated in the sheath of the psoas muscle; while the artery has a special envelope, which

constitutes the crural canal; two of the branches of the crural nerve, however, soon come into the sheath of the vessels; before them, are the two roots of the internal saphena nerve. When all the relations of the preceding organs have been examined, and we have removed the sartorius muscle and the femoral vessels, with the parietes of their sheath, we find, from without inward, the upper extremity of the rectus femoris muscle; the end of the psoas and iliacus muscles, situated in their sheath; the interstice, which separates this muscular mass from the pectineus muscle, and in which the internal circumflex vessels are situated; the pectineus muscle, and the interstice which separates it from the adductor longus, which comes next, and the direction of which is crossed by the passing of the sub-aponeurotic external genital artery; below the rectus femoris muscle, appear, the triceps, the external circumflex vessels, resting on the neck of the femur, then a portion of the fibrous capsule, which lies under the pectineus muscle, from which it is separated by a mucous bursa, which is well lubricated with synovia; below the union of the pectineus and the adductor longus muscle, is an interstice, where we find the obturator vessels and nerves, and to which the obturator externus muscle and the subpubic foramen correspond above; more deeply, is the gracilis muscle, on the inside, the adductor brevis, and then the adductor magnus, which are separated by a branch of the obturator vessels and nerves. In the lower half of the thigh, and always anteriorly, we find, under the aponeurosis, the rectus femoris muscle anteriorly, and the sartorius, which proceeds inward; we find below, the anterior and internal fasciculi of the triceps muscle, the inferior part of the adductor magnus muscle, and an aponeurotic layer which goes from the inner part of the first toward the second; this layer is perforated below by a large cord of the crural nerve, the internal saphena nerve, and rests directly on the femoral vessels, which are ranged so that the vein is entirely posterior to the artery, and they correspond to the deep face of the sartorius muscle, being situated nearer its outer than its inner edge. Before passing through the preceding aponeurosis, the saphena vein is contiguous to the outer and anterior side of the femoral vessels; finally, all these parts being removed, the femur is seen forward and on the inside.

2. At the posterior part of the region, and under the aponeurosis, we find in the first layer, the semi-tendinosus muscle and the long portion of the biceps, which are united above, and separated below by an angular space, the commencement of the popliteal space; more deeply, we find the semi-membranosus muscle alone above, below, also, the short portion of the biceps, which is external, while the first remains on the inside; more deeply, the great sciatic nerve, and the

posterior arterial chain, formed by the perforating arteries in the centre, the articular arteries of the knee below, and the sciatic artery above, which vessels are surrounded with some very loose cellulo-fatty tissue, and have, with the buttock above, and with the popliteal space below, the relations we have mentioned. All these organs being removed, we see the posterior part of the femur, and the adductor magnus muscle, which forms, as it were, a septum, between the posterior and internal faces of the region.

3. On the outside, below the aponeurosis, we find directly above, the tensor vaginæ femoris muscle, which is directed posteriorly, and below which the external circumflex vessels pass; below, the external portion of the triceps, which is situated superiorly under the first; and finally, more deeply, the external part of the femur.

4. On the inside, the relations are already mentioned; but they were considered from before backward; we will consider them, also, from without inward, from the skin toward the bone. A sub-aponeurotic layer is formed above by the gracilis, and below by the sartorius muscle, which crosses the former; under these, and at the upper part, we find on the same layer, the inner edge of the three adductor muscles, the adductor brevis being in the centre, the adductor medius anteriorly, and the adductor longus posteriorly; the adductor brevis separates the other two only on the upper third of the thigh, and the adductor medius does not descend beyond the middle third of the same region; hence it follows, that the adductor longus alone remains at the lower part. On uniting to the femur, these three muscles are situated in an angle, in which, in the centre of the region, we find the femoral vessels; if we penetrate superiorly into the two interstices formed by the three adductor muscles, we come on the external face of the obturator externus muscle, and in both interstices we perceive, as we have already mentioned, some branches of the sub-pubic vessels and nerves, and of the internal circumflex vessels; finally, we remark, that the sub-pubic foramen corresponds to the most anterior interstice.

These are the relations of the crural region; but in one point they must be studied more minutely. This is in the upper and internal part, where the sheath of the femoral vessels becoming broader, communicates with the abdomen in the groin, and constitutes the crural canal.

Crural canal. The crural canal, the upper part of which has already been mentioned, is a triangular space, or passage for the crural vessels, and is situated at the upper and anterior part of the region of the thigh, in the doubling of the fascia lata aponeurosis. Its form is evidently triangular, and results from the angular union of the pectineus muscle and of the fasciculus of the psoas and iliacus muscles, on which it rests.

Its direction is a little oblique downward and inward; we do not allude here to the direction of the openings. It is about two fingers' breadth long, and is a little more extensive outward than inward. It is broader above than below. The crural canal presents a central part and two orifices: the central part presents three parietes: one of the two orifices is superior, the other inferior.

1. The anterior wall of the crural canal is thin, particularly on the inside; it is formed by the anterior fold of the fascia lata aponeurosis, and is attached to the crural arch; it is covered by some lymphatic ganglions, the fascia superficialis, and the skin. This wall presents several openings, through which pass some lymphatic vessels, which unite the superficial and deep ganglions; one of these ganglions is sometimes situated in one of the openings.

2. The external wall is formed by the deep layer of the femoral aponeurosis, and rests on the psoas and iliacus muscles; the crural nerve is situated on the outside of this layer, and not in the crural canal.

3. The posterior and inferior wall is formed by the deep layer of the fascia lata in that portion resting directly on the pectineus muscle.

Three angles result from the union of these three parietes; one, the posterior and external, formed by the union of these last two, is the only one which is important; it contains the femoral vessels: the other two are less interesting; one is external, the other is internal.

This central part of the crural canal contains the femoral vessels in the part mentioned, which vessels are arranged so that the vein is internal. We also find there a dense tissue, interposed between the femoral artery and vein, and a lymphatic ganglion, situated on the inside and in front of the vein.

The upper orifice of the crural canal has been described, the inferior is oval, and is directed inward and forward, and contains the internal saphena vein, to which it is evidently destined; its circumference is feeble upward and inward; on the contrary, it is very resisting backward and outward, where it is formed by a fibrous arch, concave superiorly, and received in the angle formed by the junction of the crural and internal saphena veins. This inferior orifice of the crural canal is also continuous below with the rest of the triangular sheath of the femoral vessels.

The crural canal is a little longer in the male than in the female; in return, it is broader in the latter.*

* We can trace an analogy between the crural canal and its surrounding parts, and the axilla: these two parts are situated at the union of corresponding limbs with the trunk, have a triangular form, contain the principal vascular branches of the limb, and communicate with the trunk by a triangular opening.

Development. The thigh is the third part of the abdominal limb, which is well distinguished in the fetus; in the early periods of life, it is remarkable for its beauty, its roundness, and its cylindrical form; characters which depend on the abundance of the sub-cutaneous fat in the limb, and also on the slight development of its muscles; in the early periods, also, the central bone, the femur, is slightly arched anteriorly, and the whole thigh participates in this direction; after the period of puberty, the whole region becomes convex anteriorly, and acquires that force of which we have spoken. Before this period, the characters of the thigh present no sexual varieties.

Varieties. In the female, the thigh is rounder, whiter, less downy, and proportionally longer than in the male, at the same time it is also larger, especially above, on account of the superabundance of sub-cutaneous fat; its upper extremity is separated from that of the opposite side by a space which is greater, on account of the greater extent of the pelvis on which it rests; it follows, also, from this latter arrangement, that the direction of the thigh in the female is more oblique than in the male.

The thigh presents numerous individual varieties in respect to size, length, and direction; in some males, we sometimes find all the characters of the female.

The different elements of the thigh also present several varieties, which must be carefully mentioned, as some of them are extremely important in respect to operative medicine. The pectineus muscle is sometimes separated into two fasciculi; this is true also of the three adductor muscles; the sartorius is often interrupted by fibrous intersections. Meckel has known it to be deficient, and sometimes two of them to exist. The biceps may present a supernumerary fasciculus, or may have but one fasciculus, and then the term biceps is misapplied. The femoral artery, instead of giving off its deep branch an inch and a half below the crural arch, may divide much higher than usual, as at this part, or even unusually low. We have seen very recently the deep femoral artery arise in the centre of the thigh. The sciatic nerve sometimes divides very high posteriorly, and even at its origin.

Uses. The thigh plays a very important part in standing; it sustains directly the weight of the trunk, as the haunch is almost entirely blended with this latter; it is balanced between the anterior and posterior muscles, each of which solicits it in their direction. Its internal muscles cause in it the motion of adduction; the motion of abduction is less powerful.

Pathological and operative deductions. Wounds of the anterior and superior parts of the thigh, and those of its internal and central part, may be very serious, and sometimes even fatal. The femoral

artery may easily be injured in these different points. Upward and forward, however, this vessel is more particularly exposed to wounding instruments, on account of its superficial position ; in this place, also, it has been opened by certain individuals in order to commit suicide. The juxta-position and intimate union of the femoral artery and vein show the possibility of their being injured simultaneously by a pricking instrument, and also of the occurrence of a particular species of aneurism, the varicose, a species which is almost the necessary consequence of it: all the circumstances favorable to the formation of this disease, appear in this region, hence the disease has been frequently seen here. The femoral artery, and its attendant vein, are easily wounded simultaneously, below the upper third of the thigh, by a stylet carried directly from before backward, or in an opposite direction. Above this point, an instrument, to produce the same effect, must act transversely, or, at least, obliquely, from without inward, and from before backward ; anatomy accounts for these phenomena, since in the first point the artery is anterior to the vein, while in the second, these two vessels are situated side by side, the vein on the inside of the artery. The other varieties of aneurisms, besides varicose aneurism, may appear in the thigh. In this case, or when we wish to arrest a hemorrhage coming from the principal arterial trunk of the thigh, which is wounded, we may be obliged to tie it; this operation, also, is indicated for the cure of aneurism, or for certain wounds of the arteries of the leg, as we shall mention hereafter. The artery may be tied at different points, which generally depend on the part affected; when, however, a disease of the arteries of the leg or knee is to be treated, the place may be selected by the surgeon. If we wish to tie the femoral artery when it enters the canal of the third adductor muscle, as Hunter advises, we must remember, that anteriorly it is covered in this point by the sartorius muscle, being situated near its outer edge, and that directly before it an aponeurotic layer exists, which goes from the vastus internus to the adductor magnus muscle ; if we then follow these anatomical relations, and cut along the outer edge of the sartorius muscle, we divide successively ; the skin, the sub-cutaneous cellular tissue ; we leave on the inside, the internal saphena vein ; we also cut the fascia lata aponeurosis ; we next turn to the inside the sartorius muscle, and come into its sheath ;* we then divide on a director the aponeurosis which immediately covers the artery, and we raise this from without inward, avoiding on the outside, the internal saphena nerve and the femoral vein posteriorly.

* If we do not cut exactly in the direction of the sartorius muscle, we open the sheath of the triceps anteriorly, and it is difficult to find the artery. The outer edge of the sartorius is indicated by a line drawn from the anterior and superior spine of the ilium, to the posterior part of the inner condyle of the femur.

If, on the contrary, as Scarpa prefers, we wish to tie the artery, at the base of the groin, it is situated in this part more superficially; in order to come to it, we have only to divide the skin and the femoral aponeurosis, along the internal edge of the biceps, and we then find it in relation, posteriorly and internally, with its attendant vein, which is contiguous to the two cords of the crural nerve which contribute to form the internal saphena nerve; it must be raised from within outward to avoid the vein which is found in this direction. If we wish to arrive at the femoral artery in the middle of this region, we may either raise the sartorius from within outward, or from without inward, as the artery is situated at an equal distance from both edges. Operators do not agree on the place to tie the femoral artery for aneurisms, when the place is to be selected; let us examine each process in an anatomical point of view. Hunter's operation is more difficult than that of Scarpa, but it has the advantage of placing the ligature farther from the deep femoral artery; this circumstance is of advantage, as no hemorrhage follows when the ligature is removed; but, on the other hand, it exposes perhaps to hemorrhage by dividing the artery too soon, because the ligature is applied nearer the part where the artery is aneurismatic, and consequently more or less diseased; hence, it is clear, that the two processes have advantages and disadvantages, which balance each other. As, however, these processes differ in respect to the place where the ligature is applied to the artery, and also, as the points of the femoral artery, which are tied in these two cases, are situated opposite to each other, we may perhaps select an intermediate process which would combine the advantages of the two methods; this, in fact, is obtained, by tying the femoral artery in the middle of the thigh; in fact, there, it is farther from the deep artery and from the part where the artery is affected, than in Scarpa's or Hunter's process. Farther, we have mentioned some cases where the deep femoral artery arose lower than usual; in an individual presenting this variety, if the ligature had been applied according to Scarpa's process, the artery would have been tied above the deep femoral artery, or which would have been still worse, in regard to consecutive hemorrhage, directly below it. In aneurisms of the highest part of the femoral artery, the external iliac artery must be tied as we have stated; but when the tumor is developed below the deep artery, and very near it, must we, to avoid this collateral artery, apply the ligature directly above the tumor, or tie also the external iliac artery? Roux has very recently proved, by experiment, that it may be tied below the deep artery. We must, however, state, that in applying the ligature directly below so large a collateral branch, the patient is exposed to consecutive hemorrhage; but we must not think, however, that this is so much to be feared, as

in those cases where the external iliac artery has been tied below the epigastric artery; in fact, in this latter, all the weight of the column of blood sent by the heart into the artery is supported by the cicatrix, and but little of this fluid passes through the epigastric and circumflex iliac arteries; on the contrary, where the femoral artery is tied directly below the deep femoral artery, the arterial cicatrix sustains the weight of a much smaller column of blood, as the circulation is promptly and easily re-established by the deep femoral artery, which almost corresponds, in its size and direction, to the vessel which has been tied. This is undoubtedly the reason why, in these ligatures of the femoral artery, hemorrhages are less frequent than they would seem to be at first view; this exception to the general rule, to tie an artery as far as possible below a large collateral artery, can be easily explained by anatomy, and must also modify the precept in regard to the proper place for applying ligatures to the large arteries; viz. to apply the ligature as far as possible from the great superior collateral arteries, especially when, by their size and direction, they vary much from the principal trunk. When the femoral artery has been tied above, the circulation is re-established by means of the anastomoses of the circumflex arteries with the obturator, the gluteal, and the sciatic arteries, and of these latter with the perforating arteries. These communications, particularly those of the obturator with the internal circumflex artery, are sufficient in the cadaver, when the femoral artery has been tied above, to carry even a coarse injection from the primitive iliac artery into the whole thigh; ought they not then to be sufficient to give passage to the blood, which is remarkably thin? The deep femoral artery then receives the blood directly, and carries it into the lower part of the femoral trunk which has been obliterated above. If, on the contrary, the ligature has been passed below the great collateral artery mentioned, the blood is distributed into the whole posterior arterial system of the thigh, dilates the anastomoses of the perforating arteries, and, following their chain, comes into the popliteal trunk. We can then conceive the immense importance of the anastomotic chain of the preceding arteries, which form, in some measure, a supplementary canal, which is designed to re-establish the circulation between the upper and lower parts of the region of which we are speaking. In deep inflammations of the thigh, deep incisions are more necessary than in any other part, because its aponeurosis is more resisting there than any where else. The numerous sheaths which this fibrous layer forms for the muscles, explain the constant direction in which effusions of blood or pus extend in this region; in fact, are they situated in the posterior part of the thigh, in the sheath of the posterior muscles? They burrow downward toward the popliteal space, or upward toward the

buttock, the sciatic foramina, and even the pelvis, as we have said above. On the contrary, are they situated anteriorly, in the sheath of the triceps? They re-ascend or descend, separating the femur from the muscles which are attached to it. Those which form in the sheaths of the adductor muscles, may also go superiorly to the pelvis and pass into the intra-pelvic region through the sub-pubic foramen; finally, we have spoken of deep abscesses of the internal iliac fossa, and of their burrowing towards the small trochanter. The facility with which pus or blood burrow in the aponeurotic sheaths of the muscles of the thigh, has often prevented the cure of those in whom the thigh had been amputated; hence, in these cases, we must facilitate the discharge of pus as much as possible, either by compressing the stump by an elastic bandage above the wound, or by uniting this loosely, giving to it a sloping position. In no part are the two muscular layers more distinct, than in the thigh; in no part, also, are the precepts of Chiselden and J. L. Petit, in respect to amputations, more applicable, and at the same time more necessary. The form of a reversed cone, presented by the crural region, has given rise to the excellent precept to amputate it as low as possible, in order to have a smaller bleeding surface. In this operation we have always to tie the femoral artery, which is situated on the inside of the bone, the deep femoral artery, which is a little posterior, and several muscular arteries, which are situated on the inside, backward and outward. The flap operation should always be performed, so as to have an external and an internal flap. This course is founded on two anatomical reasons; first, because the vascular trunks are situated in one of the flaps, the internal; second, because the large muscles are placed on the sides of the region. Farther, after this flap operation, the femur often projects in the anterior angle of their union: this is readily admitted, when we reflect that on this side it is situated naturally very near the external surface. To avoid this projection of the bone, it has been proposed to make an anterior and also a posterior flap; but this operation presents inconveniences, which it is unnecessary to mention, after what we have stated above. The thigh has been extirpated several times successfully. To perform it, we must remember that the coxo-femoral articulation is situated three fingers' breadth below the anterior and superior spine of the ilium, and that the femoral vessels are situated there anteriorly in the crural canal. Then, whatever may be the process followed in the formation of the flaps, whether we commence by the external or by the internal, and form both of them before opening the articulation, or whether we first form one of the flaps, and then open the articulation directly, to terminate by the opposite flap, we must never forget, that the quickest mode of disarticulating the limb is to

divide the fibrous capsule very high on the head of the femur. Beclard advises us, in performing this operation, to make two flaps, an anterior, and a posterior ; this method is advantageous, as it leaves the principal artery in one of the flaps, the anterior, and may be performed very quickly ; for when the anterior flap is once made, the whole anterior part of the fibrous capsule is exposed, and is readily divided. However, in whatever mode this operation is performed, it is terrific, both for its immediate results and for the dangers with which it is attended, on account of its proximity to the trunk ; it should therefore be considered as the last resource of art ; when, however, it is indicated, it seems to us prudent to tie the femoral artery below the crural arch, before commencing it ; we thus avoid severe hemorrhage during the operation. The wound made in tying the femoral artery may serve as the commencement of the incision ; it is consequently incorrect to say, that the patient is thus subjected to two operations.

We have spoken above of the different engorgements of the inguinal ganglions and of femoral hernia ; we have considered the latter, however, only in regard to its neck, or upper orifice ; we will now examine it in respect to the lower, or to the crural canal. The tumor which forms it, glides forward and on the inside of the femoral vessels, and descends into the crural canal, raising its anterior wall ; while it continues in this point, it is very small, but afterward, it always leaves the crural canal, frequently by one of the openings in its anterior wall ; sometimes, it passes through the opening of the saphena vein, which terminates this passage inferiorly ; finally, Cloquet has seen the tumor of crural hernia descend beyond the crural canal in the sheath of the femoral vessels. In this latter case, the base of the tumor looks downward ; it is directed forward in the others, which gives the whole tumor a curved direction, concave superiorly, so that it seems to embrace the crural arch. The crural hernia, if it leaves the crural canal, is covered by the skin, the fascia superficialis, in which the vessels of the integuments of the abdomen and the superficial external genital vessels are situated, and finally, by the peritoneum ; in the opposite case, the anterior wall of this passage is situated farther in front of it. We thus see that crural hernia is situated more superficially than inguinal, and particularly than external inguinal hernia. The pus of certain congested abscesses, which have been mentioned above, also burrow into the crural canal, before the vessels of the thigh, consequently in the place occupied by the hernia : it is hardly necessary to remark, that these abscesses pulsate, hence they have sometimes been considered as aneurismal tumors. Hernia of the sub-pelvic foramen, which we have mentioned in regard to its neck and the opening through which it passes, is situated at the upper and inner part of the

thigh, between the adductor longus, the pectineus, and the adductor magnus muscles, leaving the obturator vessels behind it. H. Cloquet has described the mode of operating when it is strangulated ; we have also stated the manner of dividing the strangulating part: in order to expose it, we must cut in the course of a line drawn from the spine of the pubis to the union of the upper third with the two lower thirds of the thigh ; and after dividing the skin, the sub-cutaneous cellulo-fatty tissue, and one of the genital arteries which passes through the fascia lata aponeurosis, and the deep genital artery which it covers, we see the cellular interstice of the pectineus and of the adductor longus muscle ; we separate these two muscles, and the tumor then appears in the place mentioned.

It is only in dislocations of the femur downward and inward, that the tumor formed by the head of the femur, remains at the inner part of the thigh, on the outer part of the sub-pubic foramen. In these cases, this bony head is always covered by the pectineus muscle. When the femur is fractured directly below the small trochanter, the upper fragment is drawn upward and inward by the psoas and iliacus muscles, and the inferior is drawn outward by the rectus femoris, biceps, &c. If the fracture occurs in the centre of the thigh, the posterior muscles bring together, posteriorly, the two extremities of the arch of the femur, between which they are naturally extended, and hence a projection of the two fragments anteriorly, which it is often very difficult to overcome, even with the greatest care. The femur is often affected with necrosis; in this disease, when we wish to make incisions to find the sequestra, they should always be cut on the outside, because this is the least vascular part of the region, and where the bone is situated most superficially.

2. OF THE KNEE.

The knee is the angle of union of the thigh and leg ; its limits are formed artificially four fingers' breadth above and below the patella.

The angle of the knee is open posteriorly, and projects anteriorly, particularly when the leg is slightly flexed ; in extension, it almost disappears. This region is prominent inward and forward ; it is depressed, on the contrary, outward and backward. Externally, it presents ; anteriorly, the prominence of the patella, bounded laterally by two depressions, the internal of which is the larger ; posteriorly, a median depression, elongated from above downward, and terminated laterally by some muscular prominences, which are very distinct when the leg is flexed ; on the outside, two tuberosities, situated on the same

vertical plane, one belonging to the external condyle of the femur, the other to the head of the fibula; on the inside, only one eminence, that of the internal condyle, which is larger, and conceals the corresponding tuberosity of the tibia.

Structure.—1. *Elements.* The skeleton of the knee is formed by all the elements of the femoro-tibial articulation: first the two condyles of the femur, separated anteriorly by a pulley, the cavity of which is not very deep, and the external plane is the most extensive; second, the two superior cavities of the tibia, the depth of which is increased by the two semi-lunar fibro-cartilages which are situated on their edges; third, finally, the patella, the posterior face of which is smooth, and presents a blunt ridge, from which two smooth surfaces proceed obliquely, of which the external is the most extensive; this articulation is formed by two very firm lateral ligaments, by a posterior membranous ligament, formed in part by the tendon of the semi-membranosus muscle, by an anterior ligament, termed that of the patella, but which is only accessory to the femoro-tibial articulation, as it is in fact the end of the tendon of the extensor muscles of the leg, in which the patella is situated; finally, by two inter-articular ligaments, termed the crucial. The membrane which lubricates this articulation is very extensive and moist: it forms a great number of folds, like fringes; first, anteriorly, behind the patella and its ligament; second, posteriorly, on the crucial ligaments. The pretended adipose ligament of some authors is only a synovial band of the same kind. Two or three muscular fasciculi come from the femur, and form the sub-cruralis muscle of Meckel, which is inserted on the upper part of this synovial pouch, and form, with the popliteus, the only special muscles of this region, in which, however, many terminate or arise. Among the former, are the triceps, the biceps, the adductor longus, the semi-membranosus, and finally, the semi-tendinosus, the gracilis, and the sartorius muscles, which unite at the base of the knee, and form together what is improperly termed the pes anseris; the muscles which arise there are less numerous, and are only the gastrocnemius and the plantaris.

The aponeurosis of the abdominal limb is extremely complex in the knee; it has been wrongly represented as attached on its sides to the condyles of the femur and to the tuberosities of the tibia; below, it is strengthened by some fibrous expansions detached from the triceps, the biceps, the sartorius, the gracilis, the semi-tendinosus, and the semi-membranosus; it sends off above from its internal face, a fibrous septum to each of the edges of the femur, which arrangement forms in the knee two principal sheaths, continuous with those of the thigh, an anterior and a posterior; the first is the end of that of the triceps,

the second continues the posterior sheath of the thigh; the sheaths of the sartorius and gracilis muscles also extend on the inside of this region; finally, a last deep layer is sent by the aponeurosis of the knee on the popliteus muscle. The popliteal artery, the last section of the general arterial trunk of the limb, belongs almost entirely to the knee; it presents there one or two slight external sinuosities, and some transverse folds, which belong particularly to its internal membrane. This artery, however, merely passes through the knee, giving off to it its nutritive vessels, among which we mention, particularly, the articular arteries, which are at least five in number; two of these are superior, and proceed above the condyles to the anterior face of the region; two are inferior, and also go to the same point, below the tuberosities of the tibia; the last penetrate into the posterior part of the articulation. A sixth artery of the knee retrogrades from the anterior tibial artery; it is the recurrent tibial artery. The arrangement of these arteries in this region is remarkable; being united sometimes by transverse and vertical arches, and sometimes by a very complex plexus, they establish collateral passages, which are always open for the circulation between the upper part of the popliteal artery and the anterior tibial artery. We add, as has already been observed, that the last perforating arteries also unite to the superior articular arteries, and we shall see that the limits of these eccentric canals, by which the anterior tibial artery may receive the blood, in certain cases extend still higher, and even into the pelvis. In the region of the knee, the popliteal artery also gives off some large branches to the muscles, particularly to the gastrocnemius and the soleus. All the veins accompany the arteries, and have generally the same arrangement with them, except the internal and external saphena veins, the first of which only passes through the region, while the second partially terminates in it, sending also a branch toward the thigh In this region, also, there are generally found three lymphatic ganglions, all of which are situated posteriorly in the popliteal space; they receive the deep lymphatic vessels of the leg and knee, while the superficial lymphatic vessels go to the superficial inguinal ganglions. The nerves of the knee, like those of the thigh, come anteriorly, and on the sides from the lumbar plexus, posteriorly from the sacral plexus. The first proceed from the inguino-cutaneous, the genito-crural, and the crural nerves; the second from the small sciatic nerve, and also from the great sciatic nerve, which passes deeply through this point, and divides into two principal branches, the external and internal popliteal, from which the internal saphena nerve proceeds by two roots, which present numerous varieties. Two twigs of the crural nerve extend into this region, after following for a long time the crural artery, and unite to form the internal saphena

nerve, which also rises, as we see, by two roots, which no author has as yet observed. The cellular tissue of the knee is more abundant posteriorly than in any other point, and it is also a little looser there. Fat appears there in small quantity, except in certain points; as, for instance, under the aponeurosis, below the triceps, at the upper part of the synovial pouch of the knee; behind the ligament of the patella, where it forms a considerable body; finally, between the posterior ligament and the crucial ligaments. Three very thin mucous bursæ also are constantly found in the knee, one between the skin and the patella, another between the lower extremity of the ligament of the patella and the thin part of the tibia, the last between the inner head of the gastrocnemius and the semi-membranosus muscles.

2. *Relations.* The relations of the knee are very important, and slightly complex; the skin, the sub-cutaneous cellulo-fatty tissue, and the aponeurosis, envelope it uniformly in every part, and successively, from without inward, in very distinct layers; the second, however, is thinner anteriorly and laterally than posteriorly, where also it is almost entirely fatty; it contains in its areolæ the veins, the lymphatic vessels, the superficial nerves, and particularly, on the inside, the internal saphena vein, and posteriorly, the ascending branch of the external saphena vein. The aponeurosis being removed, we find no general layer; hence the relations must be studied in another manner. Under the aponeurosis we penetrate forward and outward, into the sheath of the triceps, where we generally find, anteriorly and at the patella, a mucous bursa, which is wrongly regarded as sub-cutaneous; in other cases, a lamellar cellular tissue, in which is an arterial plexus; then, on the same plane, the end of the triceps above, the patella in the centre, and below, the ligament of the patella and an expansion which the triceps sends forward, on the sides of, and below the patella, which expansion is soon blended with the aponeurosis; behind the ligament of the patella, a mucous bursa exists below, while above, a considerable adipose body separates it from the articular synovial membrane; the latter, on the contrary, is directly in relation with the posterior face of the patella and the end of the triceps, under which it is reflected, forming a cul-de-sac, in which the fasciculi of the small levator muscle of the synovial capsule, the sub-cruralis, are attached. Below the triceps, we also find the transverse branch of the superior articular arteries, and a loose cellulo-fatty layer, in which the patella sometimes ascends, and the synovial capsule of the articulation. On the sides of the knee, we also come, as has been said, into the sheath of the triceps, which is terminated above the condyles of the femur on each side, by strong fibrous fasciculi, under which pass the superior articular arteries; the internal of these fasciculi is formed mostly by the tendon

of the adductor magnus muscle. Farther, in this sheath, we find only the condyles of the femur, the tuberosities of the tibia, the lateral ligaments, under which pass the inferior articular vessels, and under the external, in particular, the tendon of the popliteus muscle. On the inside and posteriorly, out of the sheath of the triceps, we find, on the same plane, the sartorius and gracilis muscles, each situated in its sheath ; the sheath of the sartorius is more internal than the other, and also contains deeply the two roots of the internal saphena nerve. The posterior cutaneous nerve of the thigh descends posteriorly between the layers of the aponeurosis, and in a small separate sheath, accompanied by a vein, which goes into the external saphena vein ; then we see this vein, and one of the roots of its nerve, which presents varieties to be mentioned when speaking of the leg. More deeply, is an oblong space, circumscribed by masses of muscles ; this is the popliteal space, formed outward and upward by the biceps, outward and downward by the external head of the gastrocnemius, the plantaris embraced by the first, and the condyle of the femur concealed by both, inward and upward by the semi-tendinosus, the semi-membranosus, the first of which is the more superficial, inward and downward by the inner head of the gastrocnemius, embraced by the two preceding muscles, then by the internal condyle, which is covered by the three ; the base, or the anterior part of this space, is formed from above downward by the femur, by the popliteus muscle, which covers the posterior ligament of the articulation, and more directly by an adipose body, which separates this from the crucial ligaments, and from the synovial membrane. The space itself is contracted and less elongated below ; it contains much adipose tissue, three or four lymphatic ganglions which surround the large vessels, and a fasciculus of nerves and vessels, formed in the following manner : superficially, by the bifurcated extremity of the sciatic nerve, the internal popliteal nerve, continuing the course of the preceding, and placed a little on the outside of the median line of the region : then, on the same plane, the external popliteal nerve, directed outward, and contiguous to the external wall, particularly to the biceps muscle ; more deeply, the popliteal artery and vein, which are directly contiguous, the first behind the second, both descending from the internal wall toward the median line, which they reach in the space between the condyles of the femur. Finally, we remark, that the internal popliteal nerve does not rest directly on the vessels, and that sometimes the internal, sometimes the external only, more frequently both of them, give off at this part their filament, which goes to form the external saphena nerve ; that the popliteal artery below is situated on the outside of the nerve, crossing its direc-

tion; afterwards it again crosses it, and in an opposite direction, and assumes its normal position in the leg.

Development. In children, the knee is proportionally very large, and projects, particularly on the inside; the semi-cartilaginous state of the lower epyphisis of the femur, is the true cause of this arrangement, which does not completely disappear, until after the period of puberty. In the young child, when growing, this region is for a long time semi-flexed, which depends on the debility of the muscles, but certainly also on the habit of retaining this position, which it is forced to assume in utero; in the old man, muscular debility alone causes the same result.

Varieties. In the female, the knee is always more prominent on the inside than in the male; it is also more arched outward; this double arrangement is produced by the great breadth of the pelvis, which keeps the upper extremities of the thighs separated; hence, it follows, that in standing, the legs in the female not being separated farther than in the male, in her, also, the thighs, in order to unite with them at the knee, must make an angle which is more prominent inward, and is more depressed on the outside in proportion. The vessels and nerves in this part are often divided here prematurely, as in the elbow; in fact, the sciatic nerve is not unfrequently separated into two branches far above this region; the division of the popliteal artery is more rare, but it has sometimes been seen, as by Portal, Sandifort, and Ramsay. In some individuals, the ligament of the patella is unusually long; hence, consequently, the situation of the patella is higher than usual, and the knee is slightly flexed, even during standing; authors have also mentioned a peculiar flattening of the pulley of the femur, even from the influence of the action of the muscles alone, which disposes to dislocation.

Uses. The knee is the centre of the motions of flexion and extension of the leg; the latter, also, executes in it some lateral motions, as in semi-flexion. This region supports the weight of the whole body in standing on the knees, in which attitude the skin, being pressed between the patella and the ground, is painful. The sub-cutaneous mucous bursa prevents the skin from being lacerated, as it glides from before the wounding powers; in the same cases, the summit of the synovial membrane being drawn upward by the small sub-cruralis muscle, cannot be jammed between the patella and the femur.

Pathological and operative deductions. Wounds of the knee are not very serious, unless the articulation be injured; the extent of the articular surface explains the violent inflammation which may then supervene. The synovial membrane is situated so superficially on the sides of the patella, that these parts are easily wounded. Wounds

at the anterior part and sides cannot be attended with severe hemorrhage; this is not the case with posterior wounds, in which the popliteal artery and its attendant vein may be wounded together or separately. This latter result is necessarily produced only by an instrument which acts forcibly from behind forward, in the middle of the ham; this is confirmed by the relation of the two vessels which we have mentioned, which also accounts for the formation of varicose aneurisms in this part. The division of the sciatic nerve would also be a very severe accident, because it would be followed with a paralysis of the whole leg. Fractures of the knee are situated sometimes in the patella, sometimes in the femur or the tibia. The superficial position of the patella exposes it to fracture; but its position frequently has no effect in causing a fracture, which is produced entirely by the action of the extensor muscles of the leg. Most of these fractures are transverse; this explains the difficulty experienced by the surgeon in preventing the ascent of the superior fragment, which is constantly drawn up by the action of the muscles, while the lower fragment remains motionless; hence the union generally occurs by means of a fibrous substance, as Pibrac has observed. After fractures of the patella, united by an intermediate fibrous substance, the patient feels a weakness in the limb, and the knee is a little more flexed than that of the opposite side. Boyer distinguishes simple fractures of the patella from those complicated with a rupture of the tendinous expansion which embraces and covers it. The first are cured much more readily than the others, and with a moderate degree of separation. Longitudinal fractures of the patella are very rare, notwithstanding the longitudinal direction of its fibres, which direction seems to dispose to them; the case mentioned by La Motte proves that they are not very serious. Fractures of the femur which take place directly above the condyles, are attended with a peculiar displacement; the lower fragment, being acted upon by the gastrocnemius muscle, is brought backward into the popliteal space; at the same time, the patella is brought forward by the vibratory motion of the condyles, and the knee presents a singular deformity. Beclard, in his courses, mentioned, that he had seen in aged females, fractures of the upper part of the tibia produced by the contraction of the flexor muscles of the leg, which muscles had also drawn the upper fragment into the ham; the internal absorption which diminishes the thickness of the parietes of the cavities of the bones, and their fragility, caused by the predominance of the calcareous part in aged people, explains these fractures satisfactorily. A great degree of external violence is necessary to break the ligaments of the knee; its dislocations also, which cannot occur without this rupture in a greater or less degree, are rare and very serious.

Most generally, only one of the condyles leaves the tibia, while the other is placed in the cavity of the first; the luxation is then imperfect; it is always easy to reduce these dislocations; the rupture of the ligaments explains the want of resistance which is then perceived. The rarity of anterior and posterior dislocations does not depend, as has been said, on the resistance of the crural ligaments, which would also prevent a lateral dislocation, but upon the greater or less number of muscles, which powerfully support the articulation in this direction, while the lateral parts possess this advantage only in a slight degree. The prominence of the internal edge of the patella will alone account, as Boyer has observed, for the frequent dislocations of this bone outward, which prominence gives a purchase to the powers capable of producing this displacement. The mal-formation of the ligament of the patella and that of the anterior pulley of the femur, which have been mentioned, so dispose to this change of relations, that even the action of the muscles alone may then produce it; but when this defect is carried very far, dislocation becomes a permanent state; then the patella, situated at first on the side of one of the condyles, soon glides posteriorly; the common tendon of the triceps and rectus femoris muscles is brought into this direction, and extends beyond the centre of the motions of the femoro-tibial articulation; hence it follows, that the muscles, which were previously extensors of the leg, having become flexors, the person cannot stand. Beclard has proved, by his dissections, that this was the cause of the constant flexion of the knee in cul-de-jattes, or cripples who have lost the use of their legs and thighs, in whom also the dislocation of the patella is generally congenital. Synovial tumors or ganglions sometimes appear in the knee; sometimes they are situated in the sub-cutaneous mucous bursa, sometimes in that which lubricates the posterior face of the ligament of the patella; we have once found in the latter part, these loose lenticular foreign bodies mentioned when speaking of the gluteal region, together with an abundance of synovia. Pus may also accumulate in the former, after a contusion, to which it is exposed also by its superficial position; in one case which we had occasion to observe, the abscess was left to itself and opened into the articulation. Abscesses of the ham rarely terminate in this manner, on account of the resistance of the articulation in this direction. Collections of pus in this part also are extremely serious for another reason; they are diffuse on account of the laxity of the cellular tissue, and if left to themselves, they destroy the muscles, the vessels, and the nerves, burrow toward the thigh in the posterior sheath, or toward the leg along the tibial vessels, and in the space between the gastrocnemius and soleus muscles; some abscesses of the ham are formed by pus from the thigh or from a higher

place. Spontaneous aneurisms are frequently situated in the popliteal artery; this phenomenon has been explained by pathologists in different ways; in fact, some say, that it is caused by the compression of the artery, when it passes under the contracted soleus muscle, which compression causes the stagnation of the blood above; others have ascribed this disease to the traction of the vessels during the forced extension of the leg. Anatomy will demonstrate to us that the first opinion is inadmissible; this would be the case with the second also, if the artery were always healthy and extensible; in fact, we have seen that it forms some slight sinuosities, that it presents internally some transverse folds, which belong to its internal membrane, which folds, in fact, are in reserve to admit of the extension of the knee; but when the artery is diseased, particularly when it is ossified, the explanation of the formation of aneurism by rupture, seems much more probable, as the vessel has lost its extensibility, and has become extremely fragile. When the aneurismatic artery is obliterated, whether spontaneously or by an operation, the collateral circulation of the knee becomes more important, as it carries blood into the lower part of the limb; we can then conceive the use of the recurrent tibial artery, which carries the blood directly from the articular arteries into the anterior tibial artery.* The articular arteries are obliterated at their origin, since they arise from the popliteal artery, which we have supposed to be changed into an impermeable cord; their dilated branches, however, receive blood from the deep femoral artery, or from its perforating branches, and continue the circulation. As the superior articular arteries often rise very high, when the femoral artery has been tied for popliteal aneurism, we can conceive that the arterial trunk may not be obliterated from the ligature to the tumor; this arrangement has never prevented a cure. Farther, this fact also is connected with the action of ligatures on arteries; these are generally obliterated above and below the point tied, but only to the origin of a great collateral artery.

Besides the physical injuries of the articulation which have been mentioned, it may also be affected spontaneously in different ways; foreign cartilaginous bodies sometimes form in it; we have seen two cases of this kind,† and Beclard has often stated they arise in the synovial fringes, on the outside of the cavity of the synovial membrane, that they soon project into the articulation, and become loose by the rupture of the pedicle which supports them; hence they present in

* We have recently dissected a subject in whom the popliteal artery was obliterated on one side, and in whom, during life, the anterior tibial artery received no blood, except through this unusual channel.

† We have known one of these bodies to be developed in the adipose ligament.

their formation three distinct periods, according to the place where they are formed. The great number of the synovial fringes of this articulation explains the frequency of the development of these foreign bodies, which cause severe pains when they are interposed between the cartilaginous surfaces, and the existence of which is not perceived in other cases. The constant irritation of the synovial membrane of the knee by walking, accounts for the appearance of hydarthrosis in this region; this synovial tumor ascends first upward under the triceps, in the very loose tissue which unites this muscle to the femur; the patella is then pushed forward and the fibrous expansion of its edges yields; hence the appearance of two lateral prominences, the internal of which is the larger because on this side the articulation is weak in a greater extent. These two prominences are more tense and more prominent during the contraction of the triceps, because then they are as it were strangulated in the centre by the patella and its ligament; farther, the simple sub-patellar ganglion which we have mentioned, has sometimes been termed hydarthrosis; it differs from the latter, however, by its lower position. The knee is very subject to those more or less extensive articular diseases, vaguely termed white swellings. In this part, particularly, this term has been applied, not only to certain diseases of the bones, cartilages, synovial membranes and ligaments, but also to the morbid tumefaction of the sub-patellar adipose body, to the diseases of the mucous bursa situated before it, and to a simple disease of the fatty mass which exists posteriorly, between the crucial ligaments and the posterior ligament; finally, in one very remarkable case, we have found that the tuberculous and scrofulous swelling of the popliteal ganglions was the only disease of a knee apparently affected with a white swelling. The knee is often affected with pains in the direction of its posterior nerve; they constitute sciatic neuralgia; sometimes, particularly in coxalgia, the knee is affected with severe sympathetic pains, which have deceived physicians, and have led them to suspect a disease of the region; the sciatic nerve may perhaps be regarded as the conductor of them; from its position near the articulation of the haunch, which is affected, we may suppose in these cases that it is more or less irritated. If we wish, in the region of the knee, to tie the popliteal artery which passes through it posteriorly, where, for instance, it has been extensively wounded, a perpendicular incision must be made on the centre of the ham; we divide successively, the skin, the sub-cutaneous cellular tissue, some ramifications of the posterior cutaneous nerve of the thigh and of the external saphena vein, the fascia lata aponeurosis; we leave on the outside, the internal and external popliteal nerves; the vein should be separated from the artery, and

also left on the outside; and before it, we find the artery surrounded by several lymphatic ganglions. Although amputation near the knee has been performed successfully by several surgeons, and has been advised by Brasdor, yet it is generally considered as less convenient than that of the thigh; the extent of the articular surfaces which in this case are exposed to the irritating action of the air, are reasons for this opinion; if we decide to perform it, we must make but one posterior flap, in which the principal vessels and nerves are situated; it is usually advised to terminate by this flap, and this accords with the general rules of the operations; but the operation is performed more rapidly and more regularly, if we follow an opposite course, and introduce the knife posteriorly, and cut first the single flap. This small deviation from the rule is attended with no inconvenience, but it possesses all the advantages we have mentioned.

CHAPTER III.

THIRD PART OF THE ABDOMINAL LIMB.

The third section of the abdominal limb commences below the knee, and unites inferiorly with the foot. It is composed of the leg and the ankle.

I. OF THE LEG.

The leg commences below the knee, and is separated from the ankle by an imaginary line drawn two fingers' breadth above the summit of the internal malleolus; it is irregularly fusiform, is enlarged in the centre, and unequally thin near its extremities; its direction is perpendicular to the horizon, and is parallel to that of the opposite leg, in which it differs from the thigh. Considered on the outside, we distinguish in it three faces, more or less covered with hairs, particularly the internal: this latter is plane, and a little arched on the outside; the skeleton is very superficial there, and can be felt in every part; the external face is anterior, and uniformly convex; the posterior presents, at the union of the upper third with the two lower thirds, the muscular prominence of the calf; in a strong and

well made man, the circumference of the calf is nearly double that of the base of the leg, estimated above the malleoli; nevertheless, there are, in this respect, numerous individual varieties; the anterior edge of the leg is very prominent, like a crest; it marks one of the edges of the tibia; along the inner edge, which is a little blunt, we see the bluish prominence of the great saphena vein; finally, on the superior limits of this region, we see three eminences, all formed by prominences of bone; they are, on the inside, the corresponding tuberosity of the tibia, on the outside, the head of the fibula, anteriorly, the anterior tuberosity of the tibia, which serves as a point of attachment to the ligament of the patella. These different remarks will form the base of useful applications.

Structure.—1. *Elements.* The leg is one of the simplest of the four sections of the abdominal limb, in respect to structure; its skeleton is formed of two bones, the central part of which alone belongs to it, excepting, however, the fibula, the upper extremity of which also exists there; of these two parts, the tibia belongs particularly to the leg by its functions, while the fibula is destined more particularly to the mechanism of the ankle and the foot, as we shall see; these two bones are separated by an inter-osseous space, which is imperfectly filled with the inter-osseous membrane; they are also united directly by compact articulations, which do not admit of rotatory motions as in the fore-arm. The muscles of the leg are situated on its anterior, external, and posterior faces; the tibialis anticus, the extensor hallucis proprius, the extensor digitorum pedis communis, and the peroneus anticus, on the first; on the second, the peronei laterales; and finally, the gastrocnemius, the soleus, the plantaris, the flexor digitorum pedis communis, the tibialis posticus, and the flexor hallucis proprius, on the last. Some come from the region of the knee, and others arise in the leg and go toward the ankle and the foot. If we except the soleus, their arrangement is not essential, and will not detain us; but we must make a few remarks on this muscle, because, although described minutely in many excellent works, its importance has not been recognised; we will merely mention, that it is attached to the tibia, the fibula, and between them, to a tendinous arch, under which the posterior tibial vessels and nerves pass: an aponeurosis extends from this attachment to the oblique line of the tibia, on its anterior face, to which we shall allude hereafter, when treating of the ligature of the posterior tibial artery. We find, also, at the upper and internal part of the leg, the aponeurotic expansion of the sartorius, gracilis, and semi-membranosus muscles. The aponeurosis of the leg is strengthened at the upper part, as we have seen, by expansions, which are sent to it by most of the muscles of the knee; below, it is also strengthened, and

43

comes on the ankle; its internal face adheres to the sub-cutaneous face and edges of the tibia, and sends some fibrous septa towards the anterior and external edges of the fibula, between the tibialis anticus and the extensor digitorum communis longus, and at the same time it gives many points of insertion to the anterior and external muscles; finally, it sends also between the deep and superficial muscles, a layer which is very strong below, and more and more thin as it ascends. Thus, the aponeurosis of the leg forms four principal muscular sheaths; one anterior, one external, a third which is superficial and posterior, a fourth which is deep and posterior. We cannot regard these anterior muscles as each provided with a special sheath; the septa which separate them exist above only, and are even very imperfect; a very small supernumerary sheath usually belongs to the external saphena vein. The arteries of the leg are given off by three principal trunks, which pass through it and go downward; the anterior and posterior tibial, and the peroneal arteries; the latter, also, bifurcates inferiorly, and sends forward one of its divisions. We remark, that the anterior tibial artery, which passes above through the inter-osseous ligament, to go forward, and the tibio-peroneal trunk which remains posteriorly, are the two terminating branches of the popliteal artery, which is thus situated on the upper part of the inter-osseous ligament; the different secondary ramifications of the arteries generally anastomose with each other; but the anterior system particularly communicates with the posterior, by means of small branches which pass through the inter-osseous ligament, and are termed perforating arteries; of these, the anterior peroneal artery is the largest. Some small anastomotic arteries also exist on the outside, and unite the same systems; we have once found these latter very much developed in a cadaver, where the upper part of the anterior tibial artery was morbidly obliterated. When speaking of the knee, we have seen how the anterior arterial system of the leg communicates with that of this region, by the recurrent tibial artery. The small deep veins of the leg accompany the arteries; they are very valvular, and are arranged in pairs; the superficial form a considerable plexus inward and backward, and go into the trunk of the internal and external saphena veins, which only pass through this region, continually increasing there however. The lymphatic system of the leg is composed of a ganglion, situated below, on the course of the anterior tibial vessels, of numerous superficial vessels on the inside, which go to the superficial ganglions of the groin, and of deep vessels, which are much more rare, and which proceed to the popliteal ganglions. The nerves of the leg are given off particularly by the external and internal popliteal; they are the anterior tibial, the musculo-cutaneous, the posterior tibial, and the

external saphena branches; the internal saphena nerve, which also goes there, emanates from the crural nerve. The cellular tissue of the leg presents nothing peculiar; it forms a mucous bursa below the aponeurotic expansion termed the pes anseris; it contains some adipose vesicles under the skin only; this presents nothing particular, except the quantity of hair which exists upon it.

2. *Relations.* The skin, the sub-cutaneous cellulo-fatty tissue, and the superficial layer of the aponeurosis, are the three layers common to the circumference of the leg. As in all the other points of the limbs, the sub-cutaneous layer is more compact, is thinner, and less fatty forward, on the outside, and particularly on the inside, than posteriorly; it contains, on the inside, the internal saphena vein, the internal saphena nerve, and the largest fasciculus of the superficial lymphatic vessels; outward and upward, it contains some small terminating filaments of the inguino-cutaneous nerve; outward and downward, the musculo-cutaneous nerve, which leaves its deep position, then divides into two branches, which incline forward; backward and upward, some filaments of the posterior cutaneous nerve of the thigh; finally, backward and downward, we find there the saphena nerve and vein, which leave their special sheath.

Under the aponeurosis, anteriorly, we find the anterior sheath, in which the tibialis anticus and the extensor digitorum communis muscles unite by a septum, and form a first layer, which is attached forward to the aponeurosis, and rests posteriorly on the bones and on the inter-osseous ligament; while still lower, the two muscles which form it are no longer united, and cover by their approximation, first, the upper end of the extensor hallucis proprius, which afterwards separates them, and is situated at their level; finally, on the outside of this layer, we see the peroneus tertius muscle, which is often blended with the common extensor of the toes.

This anterior muscular layer, thus formed by two muscles above, and by four below, presents in the first point a single interstice, and two others below; the first, which is unique above, and internal in its inferior prolongation, may be termed the anterior tibial; it is formed on the inside by the tibialis anticus muscle alone, on the outside, by the extensor communis above, and the extensor hallucis proprius below; and finally, behind, by the inter-osseous ligament: it contains the anterior tibial and peroneal vessels, which penetrate into it directly from behind forward, and the anterior tibial nerve, the course of which is oblique from without inward. This latter is situated successively on the outside, in front, and on the inside of the vessels. The second and third interstices are of little importance; one is formed by the

proper and common extensor, the other by this latter and the peroneus tertius muscle.

On the inside of the leg, the tibia is found in every part, directly under the aponeurosis, except at the upper part, where it is separated from it by the pes anseris aponeurosis, and by a very humid mucous bursa, which is deeper than this last part.

On the outside, is a very strong sheath, common to the two peronei laterales muscles, one of which is superficial, and very long, and extends the whole length of the leg, while the other is deep, and extends only to its three lower fourths. At the upper part, the external popliteal nerve descends obliquely forward, and always in the sheath of which we are speaking, between the peroneus posticus muscle and the neck of the fibula; its anterior tibial branch passes directly into the anterior tibial interstice, while the musculo-cutaneous branch is situated first between the peronei muscles, along the septum, which separates the anterior and external sheaths, soon leaves this deep position, and becomes sub-cutaneous at the union of the upper two thirds with the lower third of the leg.

Posteriorly, under the aponeurosis, we penetrate into the first sheath, which contains all the muscles of the calf, the gastrocnemius superficially, the plantaris in the centre, the soleus deeply, all of which are united below in a very simple tendon, the Achilles tendon: the posterior wall of this sheath contains above the external saphena vein, which is contiguous to the end of the posterior cutaneous nerve of the thigh; the external saphena nerve, and its double root are first sub-aponeurotic, but at the same part, below, the external saphena veins and nerves become sub-cutaneous, and are contiguous to each other.* Under all the above parts, which properly form the calf, we come on the deep layer of the aponeurosis, which separates the two posterior sheaths; this layer rests directly on the flexor digitorum communis on the inside, the flexor hallucis proprius on the outside, in the centre, on the tibialis posticus and the posterior tibial vessels and nerves, which incline inward toward the corresponding malleolus, the nerve constantly remaining on the outside of the vessels. The peroneal vessels are first situated on the same plane as the tibial, and like them, consequently, are covered directly by the aponeurosis mentioned; but they soon pass deeply between the flexor hallucis proprius and the tibialis posticus, the latter of which covers them entirely below, when they have come upon the inter-osseous ligament.

Development. The leg is the second section of the pelvic limb which appears after this is formed. It is always flexed in the fetus,

* The external saphena nerve and vein are more properly termed posterior.

and presents also a very marked curve, which never completely disappears.

Varieties. The size and length of the leg vary much in individuals. The calf, a characteristic of our species, and a strong argument against the opinion of sophists, who assert that we were not born for the erect posture—the calf is more or less developed, and is situated more or less superiorly; its circumference, compared to that of the base of this region, also varies more or less from the normal state.

In the female, the calf is larger, but above the malleoli the leg is a little smaller, proportionally, than in the male. The plantaris and peroneus tertius muscles are often deficient. Sometimes the soleus muscle is inserted very low on the inner edge of the tibia. We not unfrequently find at the base of the leg, posteriorly, and in the deep sheath, a small accessory flexor muscle, analogous to the common superficial flexor muscle of the fore-arm; this supernumerary muscle generally blends in the foot with the accessory muscle of the common flexor. In a young girl, whom we recently dissected, we found in the leg a very small muscle, situated on the inside of the tibialis anticus muscle, terminated by a tendon on the tibia, above the internal malleolus, and arising very distinctly in the middle of the leg. This variety seems to us to represent, in this part, the supinator longus muscle of the fore-arm. We have also found a small fleshy fasciculus, which went to the flexor digitorum brevis muscle.

The anterior tibial artery may also be very small above, and may be very much enlarged below by the anterior peroneal artery; this is simply a development of the normal arrangement; sometimes it terminates in the centre of the leg, and is replaced below by the very large anterior peroneal artery; in these cases, the peroneal trunk is very much enlarged. We often find, between the ends of the peroneal and of the posterior tibial artery, a very large anastomotic branch, which descends obliquely from the peroneal artery; this is simply an increase of the normal arrangement; in some rare cases, it is carried to a greater extent, and then changes the end of the posterior tibial artery into a branch of the peroneal artery. We have recently dissected a subject in whom the peroneal artery was enormously developed, and might be considered as the continuation of the popliteal artery; it divided below into three branches; one of them passed through the inter-osseous ligament, and went to form the lower part of the anterior tibial artery; another represented the normal posterior peroneal artery; finally, the last passed under the tarsus, and had the common arrangement of the posterior tibial artery; the two anterior and posterior tibial arteries were rudimentary, and were distributed in the centre of the leg, constantly anastomosing with the branches which

continued them downward. The external saphena nerve often presents some varieties in the arrangements of its two roots; sometimes that of the external popliteal, and sometimes that of the internal is the larger; sometimes both come from these trunks in the popliteal space; sometimes one of them separates in the middle of the leg, from one of the branches of the popliteal nerves. Sometimes one of these roots of the external saphena nerve is situated in the gastrocnemius muscle.

Uses. The leg supports the weight of the body which is transmitted to it obliquely by the femur. Hence the advantage derived from its perpendicular direction, from the strength of its skeleton, and its numerous posterior muscles. It has been incorrectly asserted that the contraction of the soleus muscle might compress, in this part, the end of the popliteal artery; but, on the contrary, the fibres of this muscle, by drawing upon the aponeurotic arch, under which this vessel passes, dilate the opening for its transmission.

Pathological and operative deductions. We have frequently seen partial or complete ruptures of some fibres of the muscles of the calf; these are explained by the violent efforts required by leaping, walking, &c.

The most simple injuries of the leg, on the inside and along the crest of the tibia cause severe pains, while they are hardly felt in any other part. Anatomy shows, that in these other parts the skin is removed from the bones, the only resisting point of support, by elastic masses of muscles, which resist all shocks; there, on the contrary, the relations of the skin with the bones is almost direct. In the first points, the blood is effused as easily as in the occipito-frontal region, and from the same causes. Wounds of the leg, if a little deep, are often complicated with the injury of its principal vessels; hence, these vessels frequently require to be tied. To come to the anterior tibial artery, we must cut in the direction of a line drawn from the head of the fibula to the centre of the ankle, which direction is, as we have stated, that of the interstice of this vessel: we must carefully avoid its attendant nerve, which occupies the position we have mentioned; farther, we must flex the foot, in order to relax the anterior muscles of the leg as much as possible, which state of relaxation allows us to raise the artery more easily, especially if we are careful to do this with a curved instrument introduced diagonally into the interstice. It is very easy to find the posterior tibial artery below, between the Achilles tendon and the internal edge of the tibia; we must not, however, forget that it is situated in the deep posterior sheath, and consequently, that it is separated from the skin by two distinct aponeuroses; it should be raised from without inward, to avoid the nerve which accompanies it on the outside. At the upper part of the leg, this same artery is covered by

the mass of the muscles of the calf, and seems almost inaccessible, especially if we reflect that the soleus muscle which covers it, being inserted in the inner edge of the tibia, must be divided, and thus it is difficult to discover the moment when the cutting instrument has come into the interstice of the vessels: on account of these difficulties, and particularly the last, a compression of the vessels has been preferred to a ligature; this compression, however, is difficult and inefficient. We have attempted to find, in the anatomical arrangement of the parts, some sure guide by which these obstacles may be overcome; we have discovered it in the structure of the soleus muscle. This muscle, at its upper part, two lines from the internal edge of the tibia, on its anterior face, which is situated directly on this vessel, presents an aponeurosis, to which the incision should always extend; in fact, as long as we do not find it, we are certain that we are still in the muscle; on dividing it, we open the interstice of the vessels. This direction being laid down, it will be easy to tie the posterior tibial artery high up, if we make an incision parallel to the inner edge of the tibia and at least two lines behind it, which will interest the skin, the sub-cutaneous tissue, leaving on the inside the internal saphena vein and its attendant nerve, but dividing the tibial aponeurosis, the soleus muscle and its aponeurosis. The tibial artery is then exposed, and is covered only by a very thin fibrous layer of the crural aponeurosis, and should be raised with care, in order to avoid the tibial nerve, which is situated near it, on the outside. It is more difficult to find the peroneal artery than the posterior tibial; in order to come to this at the upper part, we must divide the soleus muscle, near its attachment to the fibula, but in a place where, unfortunately, there is no aponeurosis which might serve as an infallible guide on the inside. This same artery may be found lower down where it rests against the inter-osseous ligament, by making an incision on the outer edge of the Achilles tendon, which incision must include the superficial and deep layers of the crural aponeurosis; the flexor hallucis longus, and the tibialis posticus, must then be separated, for the artery is situated between them; but, if the first incision has been made near the posterior edge of the fibula, we may also detach from the posterior face of this bone the flexor hallucis proprius muscle, and we shall thus arrive more certainly to the inter-osseous ligament, on which the artery rests. When we cannot find the injured artery at the upper part of the leg, we may tie the end of the femoral artery or the popliteal artery; Dupuytren has done this successfully, in a case where the posterior tibial artery had been wounded very high up by a spicula of bone. In performing this operation, however, we must always guard against hemorrhage, an almost necessary result of the re-establishment of the circulation, as is proved

by the practice of Guthrie and Bell. Aneurisms of the upper part of the leg require only the ligature of the femoral artery; the re-establishment of the circulation, which is so easy by the anastomoses of the articular arteries with the recurrent tibial artery, does not then impede the cure, as the velocity of the course of the blood in the leg is moderated on account of the greater dilatation of the collateral arteries, and thus the tumor has time to disappear. A similar treatment would doubtless succeed in aneurisms of the lowest parts of the artery; but it is better to tie the diseased vessel above and below the tumor, to prevent the blood from coming there by a retrograde course, by following anastomoses which are naturally very much dilated, and which are presented below by all the arteries of the leg. In fractures of this region, the fragments suffer but little displacement, except that produced by the cause of the fracture; this depends upon two reasons, first, because the same muscles are inserted on both fragments; the second, because, if only one of the two bones is fractured, that which is uninjured serves, in a measure, as a splint for the other. Nevertheless, in perfect fractures, the extremities of the fragments often form anteriorly an angular prominence, which is produced by the contraction of the posterior muscles which draw the opposite extremities of the fragments towards each other. In fractures of the fibula, the fragments are drawn towards the tibia by the action of the muscles which are inserted in both bones, principally by the tibialis posticus muscle. There is no anatomical arrangement which will explain the constant direction downward and outward of the oblique fracture of the tibia. When one of the bones of this region is broken, it is impossible to stand; the reason of this, however, varies, according to the bone affected; if the tibia be broken, the leg having lost its axis, refuses to support the weight of the body, while when the fibula is broken, the foot ceases to perform its office. The superficial position of the tibia inside, its size, and also its constant and difficult functions, expose it more than any other part to necrosis. When we wish to remove the sequestra, which is often inclosed in a new bone, the internal face of this region should be selected for the incisions, on account of the thinness of the integuments. This same superficial position of the bone, which serves as the base of the leg, explains the appearance of syphilis in it, which frequently causes in it exostoses and periostoses: these tumors occur there so frequently, that the physician should always examine this part, in a patient suspected of a chronic and constitutional syphilitic affection. Varices of the leg are very common; they occur most frequently on the inside, by the dilatation of the great saphena vein and of its branches; they are less common posteriorly, in the small saphena vein, doubtless because its crural portion does not ascend so high, and

supports a shorter column of blood than the corresponding portion of the internal saphena vein. Abscesses are seldom formed in the front part of the leg: posteriorly, on the contrary, they are common in the calf: the pus which forms them may easily burrow between the gastrocnemius and the soleus muscles, especially before the latter: it may come from the ham, or even from a higher point, after passing through the former. The rules for amputating the leg are all founded on anatomical precepts; let us examine them successively; first, the operator is situated on the inside, in order to divide evenly the two bones situated on a plane oblique downward and outward, when the leg is held horizontally. For the division, we select a point situated four fingers' breadth below the anterior tuberosity of the tibia, because, at this part, the popliteal artery is divided, the nutritious artery of the tibia has not yet entered its canal of transmission, the tendons which form the pes anseris, and with them the motions of flexion of the stump, are preserved, and finally, because the length of the stump is best adapted for fitting an artificial leg. The muscles should be cut at one period as far as the bone, because they do not form two layers except posteriorly, and even in this part, near their superior insertions, they are nearly equally retractile. They are united obliquely from before backward, and from within outward, to cause the anterior angle of the tibia to correspond to one of the angles of the wound, as the bone might otherwise compress one of the flaps and injure it, and also, because the diameter of the leg is largest in this direction. Beclard has proposed, in order to prevent gangrene, in consequence of the pressure of the angle of the tibia against the anterior flap, to remove this angle obliquely. After amputating the leg, we have always to tie the two tibial, the peroneal, and the muscular arteries, especially those of the gastrocnemius and soleus muscles. Where hemorrhage supervenes after this operation, instead of irritating the stump by looking for the bleeding vessels, we should imitate the bold course of Roux and Dupuytren, and tie the femoral artery. Ribes very justly attributes the powerful retraction of the arteries of this region, after amputation, to the position of the end of the popliteal artery on the upper part of the inter-osseous ligament, a fixed point to which the first contract.

2. OF THE ANKLE.

The ankle is the angle of union of the leg and foot; it is a region which comprises the group of organs situated around the tibio-tarsal articulation, and which extends two fingers' breadth above and below the malleolus.

The ankle is much more rounded than the wrist; its transverse diameter, at the level of the malleoli, is as long as the antero-posterior diameter.

On its external surface are four very marked eminences ; a posterior, which belongs to the Achilles tendon ; an anterior, which marks externally the fasciculus of the flexor tendons of the foot, and is more prominent during the contraction of their muscles ; two lateral, termed the malleoli, which are prominences of bone. Of the two latter, the internal is larger from before backward, but less prominent and shorter, and is situated more anteriorly than the external. The preceding eminences are separated by four depressions ; they are situated before and behind each malleolus, and serve to detach them still more ; the two posterior are separated by the Achilles tendon, and are more distinct than the anterior ; the external more so than the internal.

Structure.—1. *Elements.* The elements of this region are the tibio-tarsal articulation, some tendons, an aponeurosis, the extended vessels of the leg or foot, some nerves, and a little of cellular and adipose tissue. The tibio-tarsal articulation forms the base which supports the rest ; the bony parts of this articulation are the pulley of the astragalus on one side, on the other a cavity, elongated transversely, to which the two bones of the leg contribute, a kind of mortice bounded by the two malleoli. We must also remember carefully, first, that the fibula contributes to form its outside, and touches only the outer part of the astragalus; second, that the prolongation of this bone, which forms the external malleolus, descends four lines below the opposite prolongation of the tibia ; third, that the articular bands are three strong ligaments on the outside, one only on the inside, and two others which are rudimentary, one anterior, the other posterior ; fourth, that the axis of the articulation falls nearer the internal than the external edge of the foot ; fifth, finally, that the transverse diameter of the mortice of the leg is very nearly equal to that of the pulley of the astragalus. The astragalus and its double articulation with the scaphoides and os calcis, also belong to the ankle, and likewise the inferior tibio-peroneal articulation, which is remarkable for the strength of its anterior, posterior, and middle ligaments. We shall see, hereafter, the importance and application of these facts. The ankle has no special muscle ; but few fleshy fibres are visible there, and the muscles of the leg send there merely their tendons. Anteriorly, we find the tendons of the tibialis anticus, of the extensor communis and proprius, and of the peroneus anticus ; on the outside, those of the peronei laterales ; posteriorly, the Achilles tendon, and the tendons of the flexor digitorum communis, the flexor proprius, and the tibialis posticus ; the flexor digitorum communis brevis also arises there below

and forward. The aponeurosis of the ankle is continuous upward and downward with those of the leg and foot, of which it makes a part; but its strength in this part is singularly increased; its superficial face presents, near its internal malleolus, an opening, through which an anastomotic vein passes; it is intimately attached on the outer faces of the malleoli, and unites with their periosteum; it is composed of transverse or more or less oblique fibres; it is formed posteriorly of two very distinct layers, which are those from the posterior face of the leg; this formation by two layers exists anteriorly only at the annular ligament; in some points, it presents very distinct fasciculi, which keep in place the tendons; one anterior, the dorsal annular ligament, is oblique from the tibia toward the anterior depression of the external malleolus; it is formed of two layers, the separation of which, in three points, contributes to form three grooves for the anterior muscles, of which grooves, that of the tibialis anticus is very thin anteriorly; another fasciculus of the same aponeurosis constitutes the external annular ligament; it is extended between the fibula and the astragalus, and forms, with the bone, a groove, simple superiorly, divided inferiorly, into two, by a septum. Finally, a third fasciculus, the internal annular ligament, is inserted on the internal malleolus and the corresponding part of the os calcis, and forms a kind of bridge, under which pass all the deep posterior tendons, contained in special osseo-fibrous grooves, among which there is one for the flexor proprius longus, another single above and cleft below, for the tendons of the common flexor and of the tibialis posticus, which are first united, but afterward separate. The common groove is formed by the superficial layer of the aponeurosis; the deep layer, attached on the internal malleolus and the astragalus, forms special grooves. Three considerable arteries, the two tibial and the peroneal, come from the leg into this region; all send to it some branches; one only terminates here, the peroneal. The secondary arteries are the malleolar, and the anterior and posterior peroneal. Besides the anastomoses which exist between all these branches, in the plexus which they form around the malleoli, and in which the dorsal artery of the tarsus enters, there are also others, which cause a more extensive communication between the anterior and posterior trunks, or simply between the former; thus, a constant branch establishes a communication between the anterior peroneal and the anterior tibial artery, either directly or by means of the external malleolar artery. The posterior peroneal artery anastomoses also with the posterior tibial* artery, more or less

* This arrangement of the posterior tibial and peroneal arteries is analogous to that of the radial and ulnar arteries, before the wrist, under the pronator quadratus. It is the posterior

directly, as has already been mentioned when speaking of the leg. Two veins generally follow the course of each of these arteries, and are deep like them; others form a sub-cutaneous layer; these are the two saphenæ and some of their twigs. This superficial venous layer communicates with the deep layer of the ankle by different anastomotic branches, the largest of which unites directly the internal saphena and one of the anterior tibial veins, passing through a foramen of the aponeurosis, which has been mentioned to exist in front of the internal malleolus. A lymphatic ganglion, termed the supra-tarsal, is often situated at the upper and anterior part of the ankle, in the course of the anterior tibial vessels; the deep and anterior lymphatic vessels go to it; the others ascend to the popliteal ganglions. Some of the superficial lymphatic vessels go also into the latter ganglions, following the external saphena vein; but most of them accompany the internal to the ganglions of the groin, through which they pass. The anterior, posterior, musculo-cutaneous, and saphena nerves, pass through this region, and give to it some twigs; the first two are deep-seated, the others are superficial and cutaneous. The cellular tissue is more abundant posteriorly, around the Achilles tendon, than anteriorly and on the sides; in the first point, it contains many adipose vesicles; anteriorly, but few of these vesicles exist, while none are seen at the malleoli, where the cellular tissue becomes exceedingly loose, and sometimes forms a mucous bursa; the tendinous sheaths, mentioned above, are lubricated by simple or complex mucous membranes; another membrane, which is also very constant, is extended between the Achilles tendon and the os calcis. The skin is fine on the inside and anteriorly, and more dense posteriorly and on the outside.

2. *Relations.* The skin, the sub-cutaneous cellulo-fatty tissue, and the aponeurosis, form three layers, common to the whole of this region; even the aponeurosis exists at the malleoli, for in these points it is attached to the periosteum. The sub-cutaneous layer contains, first, in front of the internal malleolus, the internal saphena nerve and vein; second, more anteriorly, the branches of the musculo-cutaneous nerve. On the malleoli, where this layer is very thin, it contains some filaments of the corresponding saphenæ nerves, and behind the external malleolus, the external saphena nerve and vein.

Below the aponeurosis, and anteriorly, we find, beside the flexor digitorum brevis, from the tibia toward the fibula, the tibialis anticus, the extensor hallucis proprius, the extensor digitorum communis, and the peroneus anticus united, each enclosed in a sheath, which has

part of a vascular circle, formed anteriorly and on the sides by the malleolar arteries: this ring is analogous to the vascular bracelet of the wrist.

been described, and which is lubricated by a very moist synovial membrane; the anastomotic branch of the great saphena and of the anterior tibial veins, passes near the internal malleolus, below the tendon of the tibialis anticus muscle; these veins, with the anterior tibial artery and nerve, are situated below the sheath of the extensor hallucis proprius, and cross its direction, while the anterior peroneal artery is concealed by that of the common extensor. All these parts rest on the bones of the leg, the anterior ligament of the tibio-tarsal articulation, and the upper part of the neck of the astragalus.

Posteriorly, the aponeurosis being removed, we see a superficial sheath for the Achilles tendon, a tendon lubricated downward and forward by a mucous bursa, and enveloped anteriorly and on the sides by a considerable adipose body, in which ramify, simultaneously, the posterior peroneal artery and some filaments of the external saphena nerve; next comes the deep layer of the aponeurosis, resting, first, on the flexor hallucis proprius on the outside, the flexor digitorum communis in the centre, and the tibialis anticus on the inside; second, on the posterior tibial vessels and nerves, which are situated in a special sheath, between those of the flexor digitorum communis and the flexor hallucis proprius; third, on the posterior peroneal vessels.

These parts cover deeply the posterior face of the tibia, of the fibula, of the inferior tibio-peroneal articulation, the posterior ligament of the tibio-tarsal articulation, and the posterior face of the astragalus.

Laterally, the aponeurosis blends with the periosteum of the malleoli, and leaves no space between it and these eminences; but lower than these latter, and posteriorly, we find the anastomosis of the malleolar and plantar vessels, the tendons which are situated on each side, in a groove, which is at first simple, but afterwards divided, and covers the lateral ligaments of the tibio-tarsal articulation, and also the corresponding faces of the astragalus. These tendons, on the inside, are those of the tibialis posticus, which proceed parallel to the inner edge of the foot, and of the flexor digitorum longus, which penetrates under the plantar arch; on the outside, those of the peronei laterales, the peroneus brevis being directed parallel to the inner edge of the foot, and the peroneus longus soon penetrating below the cuboid bone.

Development. In the child, the tibio-tarsal region is very weak; the prolonged and epiphysary external malleolus fulfils its functions only in part; hence, standing and walking are at first impossible, and are for a long time unsteady.

Varieties. The vessels and muscles of this part vary much; most of these varieties were mentioned in speaking of the leg; it is in this point, for instance, that the abnormal arrangements of the tibial and

peroneal arteries often commence here. We have seen the external malleolar artery give off the dorsal artery of the foot; this latter is then not situated in the position mentioned, but it is carried very much outward, under the flexor digitorum communis brevis muscle.

Uses. The ankle supports the weight of the whole body, and transmits it directly to the last section of the limb. Its mechanism in this transmission is very important and very curious; first, its position above the place where the inner edge of the foot rests partially on the ground, and secondly, the length of the external malleolus place the foot between two equal and opposite powers, which reciprocally destroy each other in the normal state; one would constantly tend to rotate it outward, were it not for the resistance of the other, which acts in an opposite direction. Destroy this equilibrium, or suppose it to be destroyed by disease, and the deviation of the foot, in consequence of its rotation, becomes inevitable. In walking, this region becomes the point of the lever of the foot, where the resistance to motion is situated; we can then imagine the importance of the perpendicular insertion of the Achilles tendon, and that of the posterior prominence of the os calcis. The ankle admits of motions of flexion, extension, adduction, abduction, and circumduction; the first take place exclusively in the tibio-tarsal articulation; the second belong only to the astragalo-calcanœan and scaphoid articulations. Hence, some anatomists are incorrect in saying, that the tibio-tarsal articulation admits of lateral motions which impede the mechanism of the ankle, and that of the foot. In the lateral motions, or in those of adduction and abduction, the foot is balanced in this region by two orders of opposite muscles, the tibialis anticus and posticus on one side, the peronei on the other: these muscles must establish an equilibrium, in order for the mechanism of the ankle to be regular. We shall mention, hereafter, the application of these facts in a pathological point of view.

Pathological and operative deductions. The lesions of this region are very common; this depends naturally on its violent uses, during efforts in walking, jumping, &c. Cases of rupture of the Achilles tendon have been mentioned; its extreme force, however, must render this injury very rare; we can imagine in the child, that it may be detached from the foot with the posterior part of the os calcis, which is formed by an epiphysis which does not fuse until late. The Achilles tendon is more easily divided in wounds; farther, in all these cases, it is important to keep the two ends of the tendon in contact, in order to have a narrow cicatrix, which circumstance may alone be considered as a perfect cure, since in this case only the motions preserve their strength. Different dressings have been invented for this purpose by surgeons. Wounds of this region may be attended with wounds of

the tibial and peroneal arteries; in applying a ligature to these vessels, there is nothing peculiar, except what has been mentioned when speaking of the leg. In falling, or merely in walking, if the foot does not rest flat upon the ground, it rotates in the region of which we are speaking; if this rotation is not carried far, it produces no bad symptoms; but if, on the contrary, it is very extensive, a sharp pain and other more or less serious symptoms are felt. The abnormal rotation, the cause of this disease, may take place inward or outward; hence a distinction of sprains into external and internal. In order to understand the mechanism of a sprain, we must remember the compact nature of the tibio-tarsal, the astragalo-calcanœan, and scaphoid articulations, and their mechanism. When the foot is carried in the direction of abduction or adduction, the latter articulations are normally the centre of motion; but if this motion is rendered unnatural by violence, the tibio-tarsal articulation also becomes with them the centre of the abnormal motions. In the simplest sprain, the ligaments are only bruised; but in a more complex case, they are fractured; luxations and fractures also may sometimes be produced. Several causes contribute to render an external sprain very rare, and also explain the frequency of internal sprains; these causes are, the number of the lateral ligaments, the length of the external malleolus, and the constant tendency of the foot to abduction in standing, which tendency we have explained by the internal position of the ankle, above the concavity of the inner edge of the last section of the limb. A sprain is always serious, because the rupture, or at least the bruising of the articular bands of the ankle, opposes its action, prevents walking and standing, and also exposes to a great number of more or less serious injuries of the articulations of this region. The malleoli, being pressed from within outward by the astragalus, may be broken in severe strains. The tibia cannot be fractured beyond the internal malleolus simply by the forced rotation of the foot; this is not true of the fibula, on account of its greater weakness and the flexibility which results from the first arrangement. The following is the manner in which the fracture is produced; it rarely occurs in an external sprain, but it is sometimes seen; then the astragalus presses the fibular malleolus from within outward, the peroneo-tarsal lateral ligaments yield, the fibula vibrates in its lower peroneo-tibial articulation, by which the summit of the malleolus is carried outward, while it curves above the ankle, and soon breaks. The fibula is more frequently fractured, as we have remarked, in internal sprains, which are also more common for the reasons already mentioned; the mode in which it is produced is then very different. The astragalus, which tends to go inward, causes the distension and sometimes the rupture of the internal lateral

ligament, while the external ligaments are uninjured; the malleolus of the fibula then revolves on its point against the external face of the os calcis, which pushes it upward; but the solidity of the peroneo-tibial articulations prevent this ascension, and the bone, being curved only in one point, is soon broken. In every fracture of the fibula, the inferior fragment being drawn toward the tibia, as has been said when speaking of the leg, executes a vibratory motion, by which the external malleolus is removed on the outside from the internal; the transverse diameter of the crural mortice is increased, and is no longer in relation with that of the astragalus; the external malleolus does not support this bone, and the equilibrium is destroyed between the two powers, which, in the normal state, oppose the rotation of the foot; hence lateral motions occur, which then take place only in the tibio-tarsal articulation, whenever the foot rests on the ground, which motions prevent standing. In order to cure a fracture of the fibula, we must bring the external malleolus to its usual distance from the internal, counterbalancing the action of the displacing powers, and causing the external malleolus to vibrate from without inward; in order to do this, many surgeons merely apply the common apparatus for fractures of the leg, pushing up the internal splint and bringing the external splint very low, so as to compress the external malleolus. Dupuytren employs an apparatus, the action of which is founded on the very great resistance of the ligaments of the tibio-tarsal articulation on the outside, and on the soundness of the peroneo-tarsal ligaments in most fractures of the fibula. He draws the summit of the malleolus by means of the external lateral ligaments from without inward, by carrying and fixing the foot in the direction of adduction. This very ingenious mode cannot apply to all cases, and particularly to fractures produced, as we have seen, in external sprains, and complicated with the rupture, or, at least, with the distension of the external lateral ligaments. The first apparatus, which is constantly and successfully used by Roux and Boyer, admits, on the contrary, of universal application. In violent distensions of the ankle, we not unfrequently observe the rupture of the bands which unite the astragalus to the os calcis, the rotation of the first of these bones on its axis, and its double dislocation on the leg and the os calcis; this is a very serious injury, and often requires the extirpation of the dislocated astragalus; but it may sometimes be cured by the reduction of the displaced parts. Common dislocations of the foot, in the tibio-tarsal articulation, are always serious on account of the rupture of the ligaments, which circumstance renders the reduction very easy. Hydarthrosis of the ankle is very common; it is marked externally by two tumors, situated before the malleoli, where, in fact, the articulation is the most superficial,

and the weakest. White swellings of the ankle present nothing peculiar. We not unfrequently find synovial tumors on the malleoli, in those individuals who wear narrow and high shoes ; in fact, the loose cellular tissue of these parts often rises and forms a mucous bursa from the effect of a long continued pressure : sometimes this is situated in the small mucous bursæ, which have been mentioned as existing around the tendons. We not unfrequently find a real ganglion formed by the accumulation of synovia in the mucous bursa of the Achilles tendon. Roux has proposed, for the resection of the bones of the leg in this region, a method which is combined ingeniously with the structure of the parts ; it consists in cutting upon the bones inside and outside, and in extending the necessary incisions forward, but only to the fasciculus of the flexor tendons, which must be carefully preserved. The extirpation of the foot, although mentioned by Hippocrates as not very serious, should not be performed, because it leaves exposed a very broad osseous surface, which can hardly be covered with the flaps formed only by the skin and some tendons, and also, because the lower part of the leg would be inconvenient for the application of an artificial foot. The region of the ankle is sometimes the centre of the deformity known as club-foot, in which, as Scarpa has observed, there is not dislocation of the bones, but only a rotation of them around their smaller axis ; generally, however, as Scarpa observes, the astragalus does not participate in this rotation. In one subject, however, which we dissected at the Hospital des Enfans, and in which there was a club-foot on each side, and the external deformity was well marked, we found that on one side the astragalus retained its normal position ; on the other, it was rotated, so that its inner face looked to the tibia. Farther, throwing out of view causes which are not anatomical, the debility of the internal or external lateral muscles of the ankle constitutes a common cause of this disease, by the want of equilibrium, which results from this fact.

CHAPTER IV.

FOURTH SECTION OF THE ABDOMINAL LIMB.

OF THE FOOT.

The foot is the last part, or the loose section of the pelvic limb.

Man is both bimanous and biped; two circumstances which characterize him in the series of animals.

The foot is situated in a horizontal plane, being distinguished by this from all the other limbs. It is, at least, one third longer than the hand; its breadth increases progressively from behind forward; its height, on the contrary, presents an opposite arrangement; the latter is greater on the inside than on the outside. The foot presents two faces, two edges, and two extremities. The upper dorsal face is united posteriorly with the ankle; anteriorly, it is loose, convex, and directed a little obliquely outward: the superficial veins and the tendons appear on it. The inferior or plantar face is smooth, concave in the centre, and on the inner edge, parts which generally do not rest on the ground, and which are therefore covered with a very fine skin: in standing, this face projects posteriorly, anteriorly, and on the outside rests on the ground, and is therefore callous in some parts. The inner edge of the foot is concave inward, and particularly downward; when placed on a plane, it rests upon it only anteriorly, near the great toe. At the union of the posterior with the two anterior thirds of this edge, we see a very marked tuberosity, which belongs to the scaphoides, and directly behind which the astragalo-scaphoid articulation is situated: to the centre, corresponds the inner part of the tarso-metatarsal articulation, which is indicated anteriorly by the slight prominence of the posterior extremity of the first metatarsal bone. The external edge is shorter and flatter than the preceding: it also rests almost entirely on a horizontal plane: it is convex on the outside, and is elevated in the centre by a tuberosity, which belongs to the fifth metatarsal bone, a tuberosity which serves as a guide to find the external part of the tarso-metatarsal articulation, situated behind. The two extremities of the foot are loose: the posterior forms the heel, which projects behind the ankle; the heel is rounded posteriorly and on the sides, and flattened below, and it is callous in every part. The anterior extremity of the foot is divided like the lower part of all the limbs; its segments constitute the toes, which will be examined hereafter.

Structure. The structure and the development of the foot are very similar in their general relations to those of the hand. To show its characters, we will first remark, that in the foot, solidity is considered at the expense of mobility; the tarso-metatarsal part is more developed than the anterior appendages: the most internal of the latter is situated on the same plane with the others, and is attached like them.

Varieties. In the female, the foot is smaller than in the male, in proportion to its height, and its dimensions are more beautiful. Every one knows the false ideas of beauty attributed by certain nations to the extreme smallness of the foot, which ideas cause the Chinese to compress the feet of young girls, to prevent their perfect development, to preserve that infantile grace, so much prized in this country, but for which females endure much pain.

Uses. The analogy of the foot with the hand is seen also in their respective uses. *Pes altera manus*, is a very natural remark. This analogy, however great, does not constitute a perfect similitude; in fact, the foot is marked by solidity, the hand by mobility; all which are sufficiently proved by our remarks on the structure. We shall mention, hereafter, the solidity and the relative motions of different parts of the foot; we will only remark, that in standing, it supports the weight of the body, and that its plantar face, which alone normally touches the ground, rests upon it by its extremity and outer edge only, except on a convex plane. In walking, the horizontal plane of the foot rises successively from the heel towards the toes, by bending, as physiologists say, in its anterior articulations. If this mechanism be deranged by disease, it becomes painful to walk; an instance of this is seen in anchylosis of the bones of the foot. The most extensive motions of the foot take place, as we have seen, in the preceding region. Like the hand, the foot is formed of two distinct portions, the sole and the toes; we will examine them in detail.

1. TARSO-METATARSAL REGION, OR REGION OF THE SOLE OF THE FOOT.

This is the indivisible part of the foot, of which it forms the five posterior sixths: hence, also, our remarks on the external form of the foot generally, may be referred to this region.

Structure.—1. *Elements.* The skeleton of this region is formed by the tarsus and the metatarsus, the bones of which are more or less exactly cuneiform, are united in an arch, the supports of which are represented by ligaments: these are stronger below than above; some are arranged transversely, others from before backward, so that the

whole is extremely resisting in every direction. The transverse metatarsal ligament, which unites all the heads of the metatarsal bones, and the plantar aponeurosis, the strong ligament of some authors, are the largest: they may be considered as the cords of the transverse and antero-posterior arches of the sole of the foot. Two of the articulations deserve particular notice, the tarso-metatarsal, and that formed by the os calcis and astragalus on one side, and the scaphoides and cuboides on the other. The latter, the internal level of which is fixed behind the tuberosity of the scaphoid bone, has its two extremities arranged on a transverse plane; while it is even slightly curved, so as to present its convexity forward. The first, on the contrary, is generally oblique from behind forward, and from without inward from the centre of the external edge of the foot to a similar point of the internal, between the tuberosity of the fifth and that of the first metatarsal bone, which tuberosities have already been mentioned. This articulation, also, presents some local varieties in its direction, which must be observed: on the outside, the general direction continues: on the inside, it is transverse first at the level of the first metatarsal bone; it is then antero-posterior for about three lines, and afterward again becomes transverse for five lines; finally, it goes forward and a little outward, for about two lines, and joins the external part, the plane of which has been mentioned; so that a real mortice is formed by the three cuneiform bones, in which the posterior extremity of the second metatarsal bone is received and fixed: this interlacing of the articulation causes the difficulty of amputating at the tarso-metatarsal region. At the metatarsus, the parts of the skeleton are separated by inter-osseous spaces, which are filled by the inter-ossei muscles; other muscles, which are more numerous, rest on the lower part of the skeleton, the flexor digitorum brevis communis, the flexor accessorius, the lumbricales, the abductor and flexor minimi digiti pedis, the adductor, the flexor brevis, the oblique and transverse abductors of the great toe: one only is situated above, the flexor brevis: a very strong ligament, the internal annular ligament of the tarsus, forms on the inside an arch, on which the adductor hallucis muscle is situated: a single and very thin aponeurosis is continuous with the annular ligament of the ankle, and covers the supra-plantar portion of the sole of the foot. The opposite face, on the contrary, presents an extremely strong layer, which serves at the same time as an envelope, and as points of insertion for the muscles, and also as a ligament for the skeleton; it has already been named; it is the plantar, or rather the sub-plantar aponeurosis: this aponeurosis is narrow posteriorly, but is expanded anteriorly, and is separated into five slips, which go on the transverse metatarsal ligament, on which they are attached by a bifurcation, the branches

of which embrace the heads of the metatarsal bones. Posteriorly, this aponeurosis adheres intimately to the posterior tuberosity of the os calcis, and is very thin on its edges: its cutaneous face is attached to the skin by fibrous bands, which will be described hereafter: its deep face gives origin to many fibres of the superficial muscles, between which, also, it sends some imperfect septa, which fulfil the same object. The arteries of the tarso-metatarsal portion of the foot come almost exclusively from the dorsal artery of the foot, and from the external and internal plantar arteries; the first two communicate by an anastomotic plexus, which embraces most of the sole of the foot, and establishes mutual relations between the supra- and sub-plantar circulations. Among the secondary arteries, we may mention principally the dorsal arteries of the tarsus and metatarsus, which anastomose on the edges of the foot with the inferior arteries, and near the ankle with the malleolar and the two peroneal arteries, so as to establish a very important collateral circulation between the superior and inferior arterial systems of the sole of the foot, and also between the latter and that of the ankle. Two large dorsal and external plantar veins arise deeply from the supra- and sub-plantar faces, and strictly follow the arteries of the same name, and like them, anastomose anteriorly. Two smaller veins attend the internal plantar artery. All these deep vessels communicate with the superficial vessels, particularly at the inner edge of the region; the superficial veins form on the back of this an arch, convex anteriorly, which receives the digital veins, and also those from the inside and outside of the sub-cutaneous parts of the sub-plantar face, and then go toward the ankle, where they form the saphenæ. The superficial lymphatic vessels go directly to the superficial ganglions of the groin: the deep come to them, after passing through the anterior tibial and popliteal ganglions. The nerves of the tarso-metatarsal part of the foot are also superficial and deep: the deep are given off to the back by the end of the anterior tibial, and the superficial are ramifications of the two saphenæ and of the musculo-cutaneous nerves. In the lower face, the two proper plantar nerves give off deep filaments, among which, the distribution of the external resembles that of the ulnar nerve, while that of the internal differs but little from that of the median nerve in the hand: both give off some superficial filaments, and others come from the external saphena. The cellular tissue is very loose on the back; it is there almost destitute of fat: on the lower face, on the contrary, it is remarkable for its fibrous density, and forms vertical canals, which are attached by one extremity to the skin, and by the other to the plantar aponeurosis, in which some adipose vesicles are situated, which are numerous in the heel and at the heads of the metatarsal bones. The skin is fine above; it is thicker below,

where it is constantly exposed to pressure: it is callous, especially anteriorly and posteriorly.

2. *Relations.* Let us now study the respective relations of all these elements; and in order to this, we will examine, successively, the two faces, the supra- and sub-plantar faces, the limits of which are so marked, that no one can mistake them.

1. *Supra-plantar face.* The different layers which form the back of this part of the foot, are; the skin, a very loose and slightly adipose cellular layer, containing, with the dorsal venous arch and the superficial lymphatic vessels, the end of the saphenæ nerves on the inside and outside, and in the centre, two terminating branches of the musculo-cutaneous nerve: the dorsal aponeurosis, the tendons of the tibialis posticus, tibialis anticus, extensor hallucis proprius, extensor communis, and of the peroneus longus and brevis, all of which are arranged from within outward, in the order mentioned, and are situated on the same plane; the flexor digitorum communis brevis muscle on the outside, and on the inside the dorsal artery and veins, which follow the internal edge of the foot, on the outside of the tendon of the extensor hallucis proprius, to which one of the terminating branches of the anterior tibial nerve is contiguous, not being covered by the flexor communis digitorum brevis muscle, except in the centre of the foot, where they are crossed by its inner tendon: finally, some vessels, which descend through the first inter-osseous space; the arch of the dorsal artery of the tarsus, attended by the external branch of the anterior tibial nerve, and entirely concealed by the flexor digitorum communis brevis muscle; finally, the convex part of the arch, represented by the skeleton of the tarso-metatarsal part of the foot, which contains anteriorly, in its spaces, the four inter-ossei muscles.

2. *Sub-plantar face.* Here the organs become more numerous, and their arrangement is necessarily more complex: they are all situated in the concavity of the tarso-metatarsal skeleton. The skin forms there a first layer, and is remarkable for its strength and thickness in the points we have already mentioned: it is lined in every part by a cellulo-fatty cushion, which is thinner in the centre, and the anatomical arrangement of which is very curious and remarkable in tall and heavy animals; in this layer some filaments of the external saphena and plantar nerves ramify, and also the branches of the posterior peroneal artery. The sub-plantar aponeurosis forms the third layer: more deeply, come the muscles, vessels, and the most important nerves. Near the inner edge, and in a point analogous to the thenar eminence of the hand, we find, superimposed from below upward, posteriorly, the origin of the adductor hallucis proprius muscle, the plantar vessels and nerves, and finally, the tendons of the flexor digitorum communis

longus and flexor hallucis proprius, crossing so that the latter becomes internal; anteriorly, the end of the abductor hallucis, the tendon of its long flexor, and the collateral vessels and nerves of this toe, parts which form a plane, under which the flexor brevis muscle is seen, which is attached to the first metatarsal bone. Near the external edge, in another place, analogous to the hypo-thenar eminence of the hand, we remark, first the adductor minimi digiti pedis, resting posteriorly on the bones, in the centre on the oblique tendinous sheath of the peroneus longus muscle, finally, anteriorly on the flexor minimi digiti muscle, which adheres to the fifth metatarsal bone. Between these two points, the flexor communis forms the first layer, the plantar vessels and nerves the second, in which, however, we do not find the end of the plantar arch: the flexor accessorius muscle, the tendons of this, and those of the flexor hallucis longus, the lumbricales muscles form the third; below appear posteriorly, the bones and the strong ligaments which unite them, while anteriorly, we find also the transverse abductor muscle, under the heads of the metatarsal bones, and the ligament which unites them, then the oblique abductor muscle, which conceals the end of the plantar arch, the deep filament of the external plantar nerve, the central bones of the metatarsus, the interossei muscles which separate them, and the end of the sheath of the peroneus longus muscle.

Development. Although the foot appears before the hand in the fetus, the skeleton of the sole of the foot begins to ossify before that of the palm of the hand, which is analogous to it in the thoracic limb. The different uses of these two parts explain this fact satisfactorily. During infancy, the plantar cushion presents but little resistance, the skin which covers it is thin, not callous, and the arch of the tarsus is not very distinct, all which circumstances contra-indicate the erect posture at this age.

Varieties. Besides the varieties in the general form, which we shall mention, the sole of the foot presents some special varieties, which are very important: thus we have found in two cadavers four cuneiform bones, and the cuboid bone corresponded to the last metatarsal bone. From whatever source the arteries of the sole of the foot arise, it is of little importance to the region, provided their arrangement is normal; but sometimes, anomalies in origin are attended with those of position: hence, sometimes the dorsal artery of the foot arises from the anterior peroneal artery, and is situated in the middle of the back of the foot, under the flexor digitorum communis brevis muscle.

Uses. The tarso-metatarsal section of the foot forms its most solid and resisting part; this supports the weight of the whole body in standing, whence the immense importance of the sub-plantar arch.

which protects the vessels, muscles, and nerves from a pressure, which would cause severe pain, and would also injure their functions; in standing, however, on an uneven and convex surface, the vessels may be compressed, which accounts for the broad vascular anastomoses between the two faces of this region. Remark also the admirable precautions taken by nature for standing and walking; she has increased the density of the skin of the lower face of the foot, and has lined it with an elastic cushion, which prevents it from rubbing on the surfaces of bone: finally, the different parts of this plantar cushion have a fibrous envelope, the resistance of which is calculated according to the weight of the animal;* this envelope prevents an increase in the breadth of the adipose bodies, which would diminish their protection of the skin. Farther, the concavity of the sub-plantar face of the foot presents another advantage also, that of facilitating walking, especially on an ascending plane; as the sole of the foot can thus embrace the inequalities of the soil, and be in a measure hooked with it. In standing or walking, the inferior ligaments, the true supports of the tarso-metatarsal arch, are much fatigued by their constant tension, hence severe pains or an aching of the feet. In order to understand the mechanism of the ankle, we have already mentioned the manner in which the inner edge of the foot rests on the ground: we shall, therefore, omit it in this place: the special motions of this region are very obscure and unimportant, except those of the astragalus on the scaphoides and the os calcis; but those belong to the ankle, as we have seen. We have mentioned the extreme sensibility of the skin of the sole of the foot, and particularly the close sympathy between it and the diaphragm, so that the slightest tickling of this part causes the most rapid convulsions of this muscle, and all the phenomena of laughing. Finally, although remote from the centre of the circulation, the sole of the foot, like the palm of the hand, is habitually very warm, and the seat of an abundant exudation, especially in some individuals.

Pathological and operative deductions. In some individuals, the plantar arch hardly exists, and in standing, the whole foot rests on the ground; hence, difficulty of walking and pains; this deviation of formation is termed *pied-plat*, or flat foot. Sometimes the sole of the foot does not touch the ground, this is the *pied-équin*, a deviation of formation, in which, as in the digitigrade animals, the toes alone serve as a base of support; finally, the sole of the foot is sometimes permanently rotated, club-foot; in these cases, sometimes the back and sometimes the lower face of the sole of the foot are directed inward,

* The horse, the elephant, and the lion, are remarkable in this respect.

the external or internal edges resting on the ground; the ancients termed the former kind valgi, and the last vari. We have already mentioned the manner in which they are produced. Wounds of the sole of the foot may penetrate from one of its faces to the other, anteriorly, at the metatarsus; those which affect exclusively the inferior soft parts are much more serious than the superior, on account of the number of vessels and nerves in this direction; in the torrid zone, these wounds frequently cause symptoms of tetanus; doubtless, the imperfect injury of the nerves, and the pains which result from them, are the causes of these symptoms. If the dorsal artery of the foot be wounded, it may easily be tied along the outer side of the tendon of the extensor hallucis proprius, which is readily seen by flexing the great toe; the external plantar artery may be tied in many points. In looking for the dorsal artery of the foot, the surgeon must not forget that it may be abnormally situated on the outside, as we have stated, and then it cannot be found by cutting on the external edge of the tendon of the extensor muscle mentioned above. The tarso-metatarsal skeleton is formed so firmly, and its different parts are so thick, that great force is necessary to fracture it; these fractures are frequently produced by the fall of a heavy body, or by the wheel of a vehicle, and then all the elements of the foot are crushed; this injury generally requires amputation. If we except dislocation of the astragalus, which we have already mentioned, this accident seldom occurs in the sole of the foot, the articulation of which is extremely compact, and admits of but slight motions. In standing and walking, the foot swells because its vascular plexus is distended; this is the reason why a shoe which at first appears to fit becomes much too small and painful; for the same reasons, the transverse diameter of the sole of the foot increases a little, and the two edges of the foot are pressed with a much greater force, and become more and more prominent, by the slight collapse of the plantar arch; ampullæ or phlyctenæ are the first effects of this pressure, when continued for any time; if this exist for whole months, it produces callosities, or corns; the first are simply indurations of the epidermis; the second consist in the accidental formation of a subcutaneous mucous bursa, in which synovia accumulates. The skin of the sub-plantar region of the foot is always the seat of a fetid transudation, the suppression of which has often caused serious symptoms; its extreme abundance is considered by Lobstein as a disease; it is, perhaps, rather a symptom of disease. The dryness or the moisture of the sole of the foot, and its greater or less degree of heat and cold, furnish pathologists with important signs in deep diseases of the organism. The sympathetical relations between the diaphragm and the sole of the foot have been employed to cause respiration in newly

born children, or to re-establish it in persons who have been suffocated; finally, this part, by its sensibility, its sympathy, and the number of its vessels, seems very proper for revulsive applications, which are daily used. Inflammation of the back of this region is less serious and less painful than in the opposite face; the resistance of the skin and of the aponeurosis, which is very great in this latter point and less in the first, and particularly the differences which have been mentioned in the sub-cutaneous tissue, are evidently the causes of this pathological difference.

We have observed at the Hospice Bicetre an individual, in whom the motions of the foot were very stiff; it could not be flexed in walking, which caused a continual lameness; upon post mortem examination, we found an anchylosis of the whole plantar part of the foot. Partial anchylosis of the bones of the foot is much more common, and causes much less trouble. Different diseases may require an amputation of the foot in different points; its extirpation is never necessary. Amputations may be performed in the tarso-metatarsal articulation, or in that of the astragalus and os calcis, with the scaphoides and cuboides: in the latter, which Chopart has described, and which Richerand has improved by using the relations of the tuberosity of the scaphoides with the articulation, all the flexor tendons of the foot are divided, while the extensors are uninjured; hence, the stump is turned over in the direction of extension, and in walking, its cicatrix presses on the ground. The amputation in the tarso-metatarsal articulation, for which Lisfranc has proposed a very advantageous process, is more difficult, and is applicable to fewer cases, but it presents the very great advantage of preserving in the sole of the foot its flexor and extensor tendons, which facilitates standing and walking. Farther, Lisfranc's process is founded strictly on the anatomical arrangement of this region: in order to perform it, we must remember, first, that the soft parts are thin upon the back of the foot, while the sub-plantar muscles are extremely thick; hence the direction to form a single inferior flap; second, that the tarsal articular surfaces are very high on the inside, and lower on the outside; hence the precept, to make the short flap in this latter direction, and the long in the first direction, rounding it from without inward; third, that the level of the articulation on the inside corresponds to the centre of the internal edge of the foot, while on the outside, it is more evidently situated behind the tuberosity of the fifth metatarsal bone; fourth, that the articular line, which is generally oblique inward and from behind forward, is a little curved. The two plantar arteries below, and above, the dorsal artery of the foot and the dorsal artery of the metatarsus, must be tied after this operation. Bouchet, of Lyons, has extirpated, with success, the last

three metatarsal bones and their corresponding toes; we may extirpate even the internal, but the operation is much more serious, if not directly, at least in its consequences; for in standing and walking, the head of the first metatarsal bone affords a useful point of support for the inner edge of the foot. We cannot tell from experience what would happen in this case, but anatomy would lead to the opinion that standing would be painful, and that the foot would turn so that its lower face would be outward.* For these reasons, we consider amputation of the first metatarsal bone as rational only in cases where its head is diseased; in any other case, we think it better simply to extirpate the great toe. We think that the opposite course has been regarded too lightly by authors.

2. OF THE TOES.

The toes are the terminating appendages of the foot. They establish the greatest analogies between the foot and the hand; hence we might refer for their description to that of the fingers; this, however, is inadmissible, since, in considering the toes and fingers as very analogous, we must not pass over the differences which characterize the former.

The toes are five in number, and have no special name, except the extreme two, which are known as the great and the little toe; the others, and even these, are termed by their numerical position, from within outward.

The length of the toes is such, that, in the natural state, the second exceeds all the others, next comes the first, and then the others follow successively, from within outward. The second toe is analogous to the middle finger in the hand, not only in respect to its length, but also in the arrangement of its muscles.

All the toes, except the first toe, are generally curved downward; this direction, however, is increased by the pressure of narrow shoes; the toes, in the natural state, are all situated on the same plane; the first is not more moveable than the others, an arrangement which characterizes the foot.

The toes are shorter, and, if we except the first, are smaller than the fingers. These are almost the only points in which their external

* This opinion is confirmed by a recent case: an unfortunate peasant, who had lost his great toe and the metatarsal bone which supported it, came to the *Central Bureau for admission to the hospitals*; his foot presented the deformity we have stated, whenever it was rested on the ground. It was difficult to dissuade him from having more of the foot removed, as he had been advised.

surfaces differ. We will also add, and it is extremely important, that the attached extremity of the toes is concealed more deeply than that of the fingers, the inter-digital membrane, which unites them in the fetus, continuing in a greater extent; the base of the inter-digital angle of the toes is ten lines distant from the metatarso-phalangean articulation.

Structure. If we except the first toe, the toes have the structure of the fingers in miniature. The phalanges are equal in number and similar in form, and are united by articulations which resemble those of the fingers; they form their skeleton; some sesamoid bones develop themselves more promptly than in the fingers, in the anterior ligaments of their articulations, which must doubtless be attributed to the greater and more constant friction exercised on them by their flexor muscles. In respect to the extensor muscles, the toes, in general, are better provided than the fingers; they have two common extensors, a large and a small; this latter sends no tendon to the small toe, and the former sends none to the large toe, which has its proper extensor. The lumbricales muscles of the last four toes join their extensors, and contribute to form their dorsal fibrous membrane. Finally, the great toe and the second toe have two extensors, like the index finger and the thumb; the third and the fourth toes have one more than the middle and ring fingers; the little toe, however, is not so well provided for as the little finger, as it has only a tendon of the common extensor, which, however, is frequently joined by a tendinous slip from the tendon of the peroneus anticus muscle.* The flexor tendons of the toes resemble those of the fingers in respect to the number and arrangement of the sheaths which envelope them; they differ only in respect to the unequal size of their tendons, and also because the longest flexor is phalangettian. Some lateral adductor and abductor muscles exist here, as in the hand; the great toe has an internal and two external, one of which is oblique, and the other transverse; in this respect, it is better provided for than the thumb. In the others, the arrangement is the same as in the fingers, except that the adductor and abductor muscles of the second toe come from the dorsal inter-ossei; while in the hand, on the contrary, this character is presented only by the middle finger. The arteries, veins, and lymphatic vessels, are arranged exactly as in the fingers. The nerves are also similar: on the back, they come from the musculo-cutaneous and the saphenæ nerves; the filaments of these latter are confined, in the normal state, to the great and little toes. In the lower face, the nerves of the toes are given off by the plantar

* The peroneus anticus is analogous to the proper extensor of the little finger, which in the foot has received another destination.

nerves; the internal sends twigs to the first three toes, and to the inner side of the fourth, as does the median nerve to the fingers; the external extends to the little toe, and to the outer edge of the fourth; it is analogous to the ulnar nerve. The skin, the nails, the cellular and adipose tissues, have no characters which have not been mentioned when speaking of the fingers. We often find a mucous bursa on the inside of the metatarso-phalangean articulation of the great toe. Notwithstanding the analogy which approximates, as we have seen, the elements of the toes and those of the fingers, we have pointed out the differences between them; but the relations of their elements are almost perfectly similar, and hence, details on this subject would be merely repetitions, after we have described the relations of the fingers.

Development. The toes are the first part of the pelvic limbs and of the foot which are well marked in the fetus. We have already mentioned the membrane which unites them all in the early periods; we add, that their separation commences late and is soon arrested, so that in the normal state, and even in the adult man, the toes are also united at their base, to a certain extent, almost as in the gallinaceous birds.

Varieties. In children, the toes are almost straight, and very moveable, as the natural proportions are not yet destroyed; but at a later period, the use of shoes arrests their growth, and causes them to assume a very curved form, so that they frequently touch the ground, not by the whole of their lower face, but by their ungual extremity only; their mobility often decreases very much, and they become stiff in consequence of the fusion of their phalanges. When the nails are left to themselves, they grow slowly, but almost indefinitely, and assume the curved form of the claws of carnivorous animals.

The most special varieties of the elements of the toes are unimportant; they produce no modification in the general arrangement which has been mentioned; these varieties consist particularly in the increase or diminution of the tendons of the extensor or flexor muscles; all the others are similar to those of the fingers.

Uses. The toes admit the motions of flexion, extension, adduction, abduction, or circumduction. Sometimes, they alone support the weight of the whole body, as in standing on the end of the feet; this is their common function in the digitigrade animals. In walking, and in all its varieties, the toes are detached from the ground by a motion of rotation, the centre of which is situated in their ungual extremity, which is supported the last.

Pathological and operative deductions. The number of the toes may be greater or less than in the normal state, as has been said; in the first case, which is more rare, sometimes the supernumerary toe

has the texture of the others, sometimes it has only their form, being simply a vegetation, which may be removed with a knife. This excess of number has been observed to be constant in certain families. All or some of the toes may be united as far as their loose extremity; sometimes, as we have observed, they are imperfectly separated; these deviations of formation, which are simply caused by an arrest of development, may easily be remedied by incisions.* Narrow shoes often cause the forced flexion of the toes; at the commencement, this deviation may be arrested by rest and the use of larger shoes; but when long continued, the phalangean and metatarso-phalangean articulations are deformed, and the toe always preserves its wrong direction; this deviation may also result from the retraction of an extensor tendon, the division of which has sometimes cured the disease. In these cases, the extremities of the toe and toe-nail rest on the ground, in standing; hence, severe pains, which render this almost impossible; pains which are produced by the crowding of the nail into the matrix which surrounds it; these morbid phenomena are also much more marked in walking, at the moment when the pulp of the toe is detached from the ground, after the rotatory motion we have mentioned; in these cases, the extirpation of the toe is often the only mode of cure. In standing and in walking, the pulp of the toes being pressed by the ground, forces the nail from below upward; and when this is cut too short, and its extremity does not extend beyond that of the toe, its angles irritate it, and cause the inflammation of the fold of skin which surrounds it; the long continued pressure of shoes upon the extremity of the nail causes the same result, by crowding back the sharp and attached edge of the nail against the base of its matrix. This is the very painful inflammation described as onyxis; as it affects the secretory organ of the nail, it may be attended with different alterations of the nail, as its loss, its softening, &c. The pressure of shoes, which produces most of the diseases of these small organs, is also the cause of the development of corns; tumors always form by a kind of local hypertrophy of the horny layer of the skin; the thickening of the epidermis, which is also remarked, is entirely accessory. On the inner

* Since this article and that on the fingers were written, we have seen a hand in which only two fingers existed; the most external, which at first view resembled the thumb, was clearly formed by the fusion of the thumb and index finger; in fact, its first phalanx rested on the two metacarpal bones, and although it presented a phalanx and a phalangette, we also found, in the inner part of the articulation which united these two bones, a rudiment of the phalangine. The other finger corresponded to the middle finger in length; it was formed as in the normal state. Farther, in the same preparation, there were only three metacarpal bones; the first two were articulated superiorly and inferiorly, and in this latter direction they were united, as we have already said, with the first finger. We could easily discover all the bones of the carpus, but they were all fused and united in one.

face of the metacarpo-phalangean articulation of the great toe, we often find a chronic engorgement of another character; this is a real ganglion, developed in the mucous bursa which has been mentioned; we have dissected several of them, and have never seen that the cyst communicated with the synovial membrane of the adjacent articulation, as some authors assert. The toes, like the fingers, may be diseased with panaris; they are soon affected with cold, and then gangrene easily supervenes: it is asserted that this is caused by the distance of the toes from the centre of the circulation; anatomy, however, has shown us, that the circulation of the toes is very active, and takes place by very numerous vessels, in proportion to the size of the organs: this is a precaution taken by nature, as in many other extreme points of the body, the nose and the ears, in order to correct, as much as possible, this tendency to chill, and consequently to congelation; this precaution demonstrates, that the above explanation is perfectly gratuitous. The broad surface by which these parts are exposed to the air, and the rapid chill which then ensues, is the true and the only cause which can be admitted. The phalanges of the toes are rarely amputated, but their extirpation is admissible, for which we must not substitute the amputation of the metatarsal bones, except when their heads are diseased. Farther, this extirpation is more difficult than that of the fingers, on account of the deeper position of the metatarso-phalangean articulation.

THE END.